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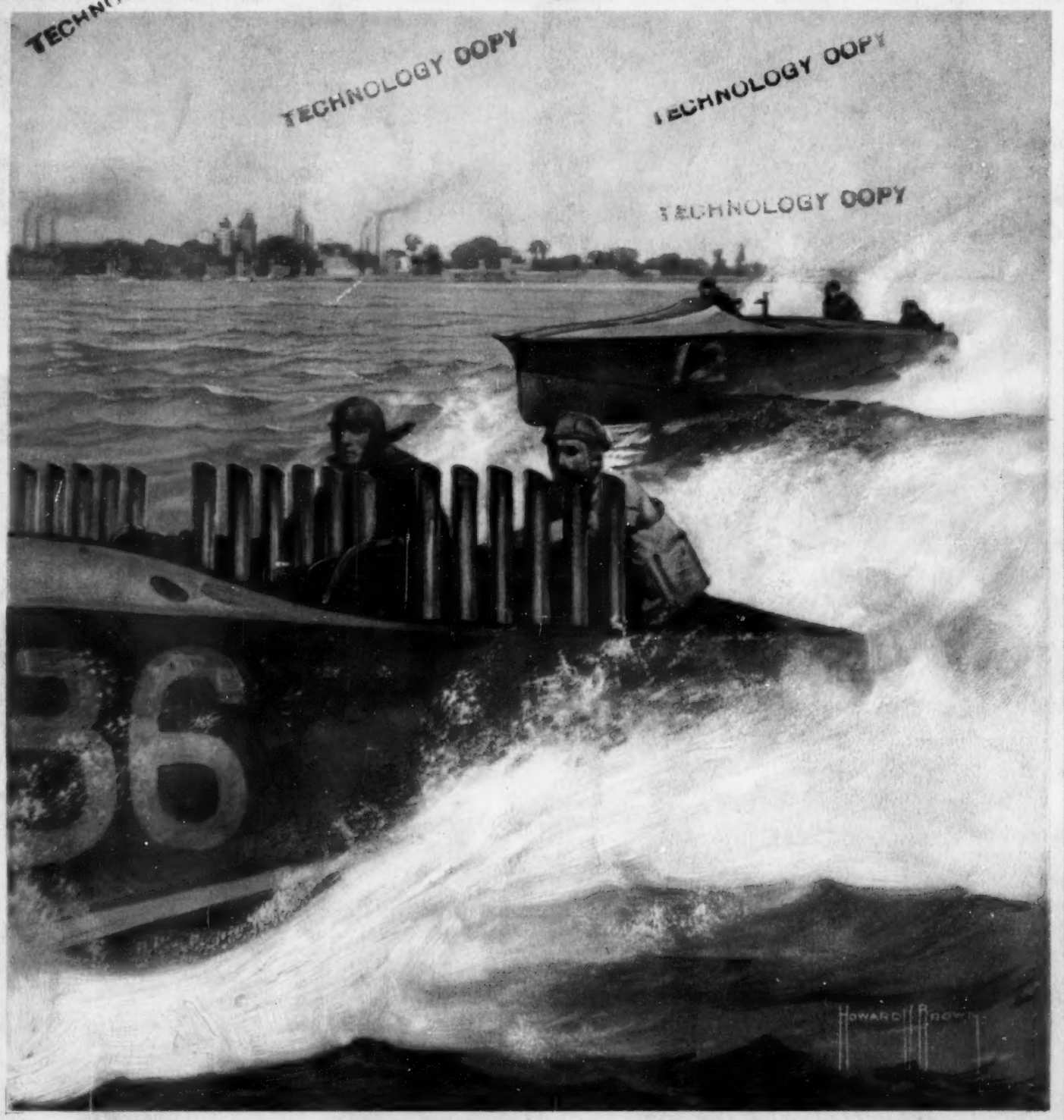

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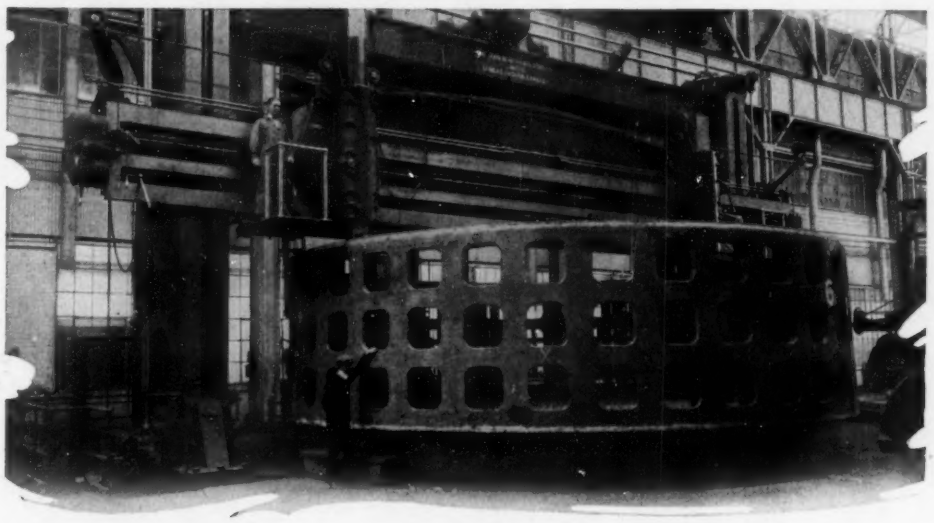

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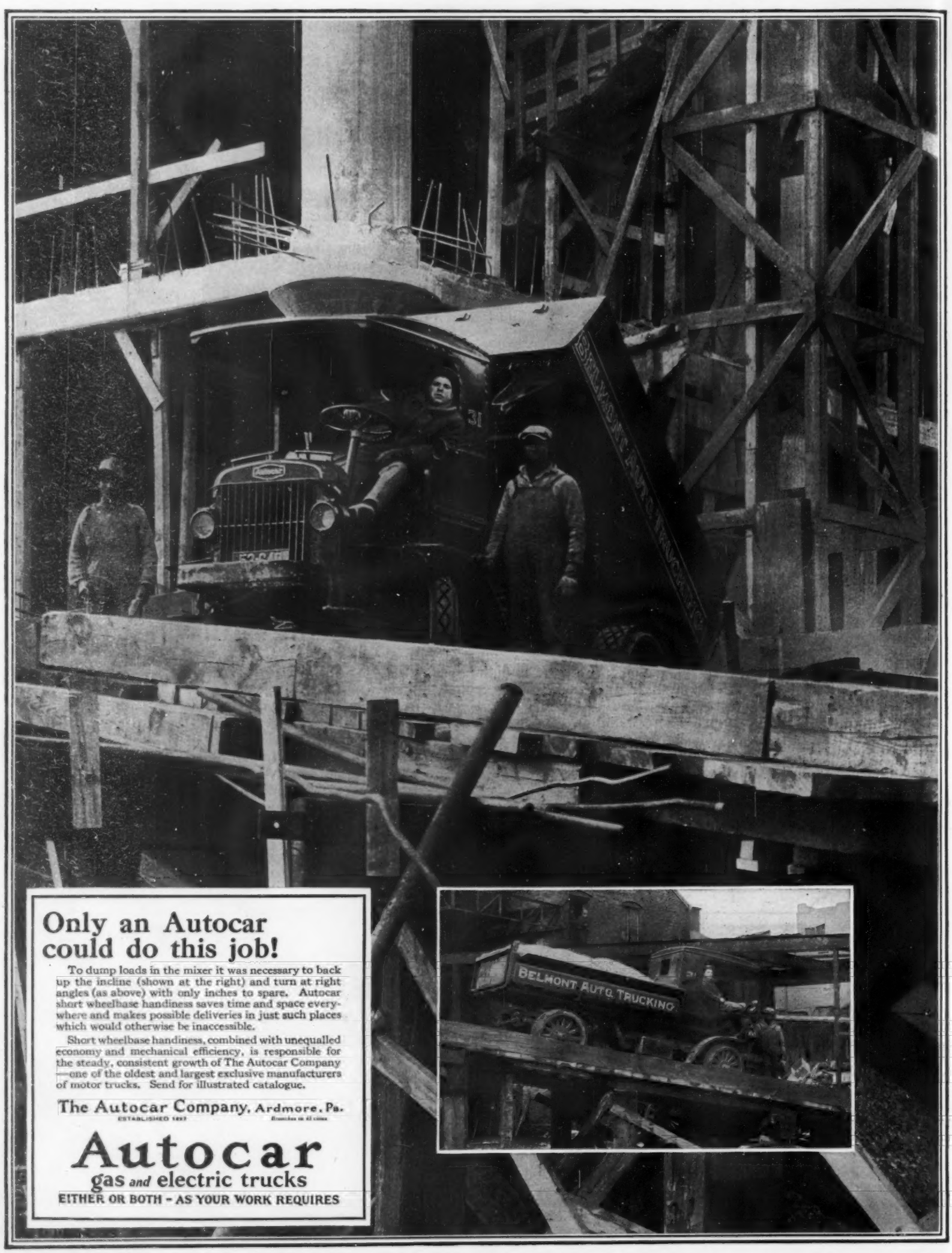

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With the Editors

ONE of our contributors who scores about as low a percentage of rejection as any of them is Captain Edward C. Crossman. Before the war, this gentleman was plain Mr. Crossman. He was typically the sort of person who gets called an enthusiast if you are interested in his hobby, and a nut if you are bored by it. The Crossman hobby was, and is, small arms of every description, with the ammunition therefor. Mr. Crossman wrote freely and enthusiastically and entertainingly on all phases of his hobby, for the SCIENTIFIC AMERICAN and for any other periodical that would buy his manuscripts or (we suspect) take them as a gift. At the same time he practiced what he preached, to the extent that he was one of the country's leading civilian marksmen, and a welcome visitor and consultant at all the commercial testing fields and small arms factories, where any opinion which he might express was received as of great weight. When the war came, Uncle Sam reached out his long arm and put Mr. Crossman in a uniform, where he would do the most good—which is to say, he was made instructor in the care and use of rifle and revolver. Since then he has been Captain Crossman. His literary productivity fell off, for obvious reasons, during the period of conflict; but today his typewriter is again at work. He is just as interesting and just as authoritative as he ever was, but by no means so prolific; so that an article from him is rather more of a treat than it used to be. For a graphic demonstration that what he writes is altogether worth reading the reader need but refer to page 152.

A CONTRIBUTOR whom we have always with us is our good friend Dr. Russell. Appearing every month as it does, there is perhaps a little tendency to take his page for granted. In point of fact it is one of the outstanding features of our columns, and has been so throughout the years during which he has been in charge of it. We are often surprised, when we undertake a little canvass of our readers to learn what interests them, to find how many men of large affairs express a leaning toward this science, which of all the sciences still remains untouched by contact with the cold realities of life, still rejoices in the characterization "pure" as against the commercial applicability which all its sister subjects now enjoy. When we find bankers and automobile manufacturers, prominent wholesalers and leading lawyers, eager to testify to the place which Dr. Russell's monthly talks hold in their estimate of the SCIENTIFIC AMERICAN, we are forced to the conclusion that astronomy, like politics, makes strange bedfellows.

A SOURCE of numerous interesting and important articles for the past six or eight years has been the Mellon Institute. Our readers are more or less familiar with this organization, and its Industrial Fellowship plan, under which individual manufacturers or associations of manufacturers are able to endow specific researches, and get them done by people of greater competence, under better surroundings, with better and more complete equipment, than would probably be the case if they were to attempt to work entirely on their own resources and under their own direct supervision. Just to mention a few cases that come to mind out of many, we have at one time or another had surprising developments to picture in the baking, dyeing and laundering industries, from this source. The names attached to these stories are usually different, but the Mellon imprint stamps them as important and authoritative; and this is no less the case with a story like Dr. Tressler's, this month, in a comparatively obscure field, than it is with one on a new technique of bread-making which obviously involves us all.

THE graphic description of the making of film, on page 169, is in line with a policy put into effect within recent months. There are many industrial processes of extreme interest which can thus be told pictorially. Soap and tires and candy occur to us, offhand, as among those which we have covered in this way. The graphic story of the pictures, with the brief covering afforded by the captions, often tells the tale of a complex machine process more effectively than any amount of sparsely illustrated text could possibly tell it; and these full-page photographic treatments of industrial subjects will continue to be a feature of our columns.

WHY is a revolving door? One answer might be, to embarrass fat old ladies; another, to provide a whirligig for the mischievous street gamin. More sober consideration would probably dictate the reply that the revolving door is intended to prevent the drafts which sweep through the corridors of a large building when doors of the more familiar type are opened on a cold day. This, to be sure, is one of their aims; but it is far from the only service that they render. They save a lot of valuable ground-floor space by making it unnecessary to maintain large heated vestibules. And perhaps most useful of all is their ease and certainty of operation in large buildings, where high winds outside, cold air on either side, the proximity of elevator shafts, or some other reason less easily defined, creates heavy unbalanced air pressure on the conventional door and makes it difficult to open. We have extreme cases in our own Woolworth Building, when it becomes quite impossible for the lighter and frailer among the ladies to open certain doors at all, against the pressures that sometimes exist. Just how the revolving door came into being, what it is, what it does and how it does it, is a story with no little of romance behind it. It will be told in an early issue by one of our regular contributors, Mr. A. G. Ingalls.

MR. INGALLS, by the way, whose name usually appears in our table of contents, does one very difficult job for us each month which does not get his name into print; and he does it well. We refer to the SCIENTIFIC AMERICAN Industrial Digest of the smaller technical developments of the month. The preparation of this involves an immense amount of reading in specialized publications which are not notable for their easy presentation of material; it involves the use of good judgment as to what should and what should not be abstracted in our columns; and it calls for real skill in telling, in a paragraph, the substance of what the original author told to his technical audience in a column, a page, or many pages. We were not at all confident, *a priori*, that we could find anybody outside our regular staff to do this delicate job to our satisfaction; and we did not just see where any of the regulars was going to get the time to do it. We think Mr. Ingalls has solved the problem; what do you think?

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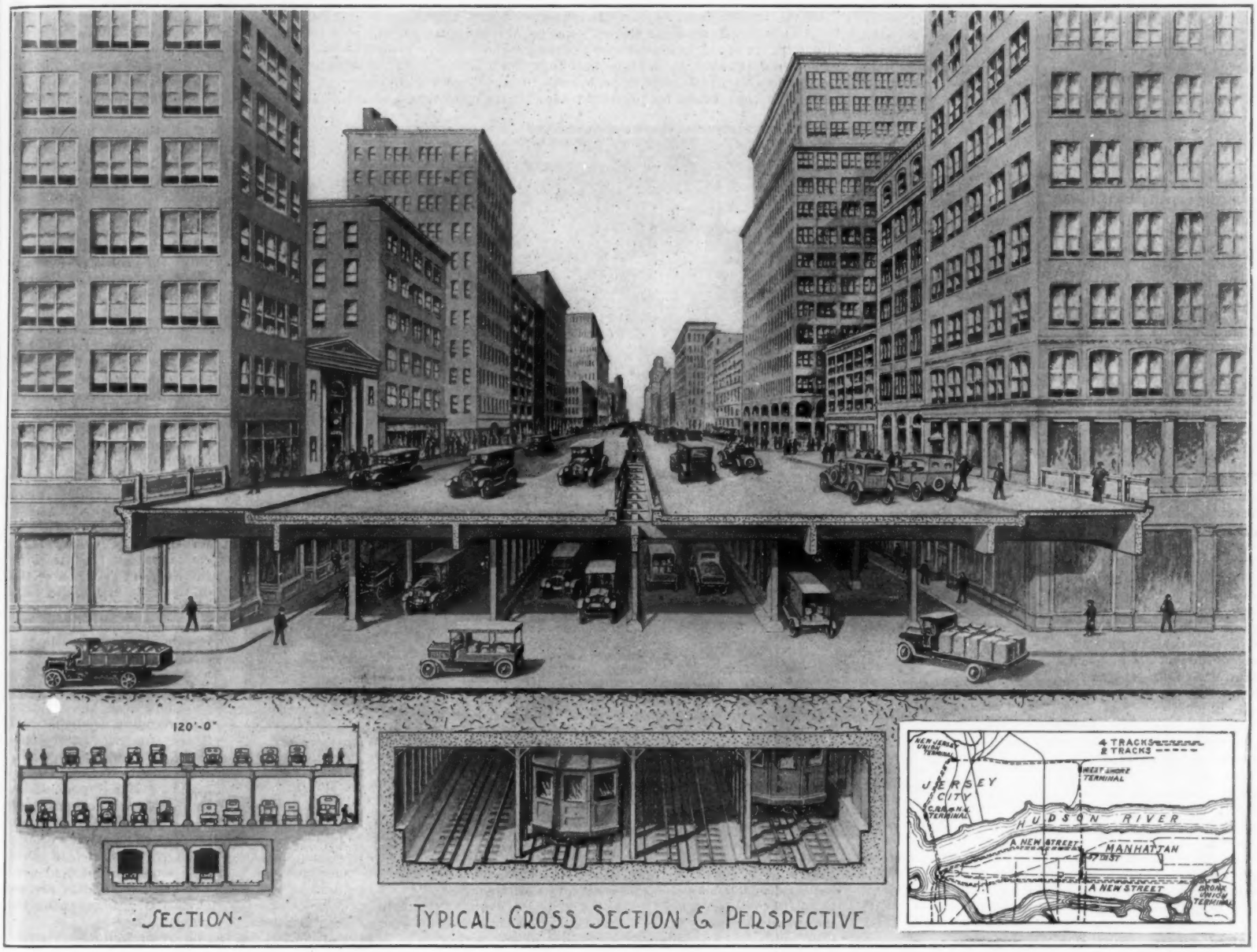
SCIENTIFIC AMERICAN

THE MONTHLY JOURNAL OF PRACTICAL INFORMATION

NEW YORK, SEPTEMBER, 1924



THE Transit Commission, through its Consulting Engineer, Daniel L. Turner, has developed a comprehensive plan for the future handling of the suburban traffic of the City of New York, and of extreme interest to all municipal traffic engineers. These plans, which are tentative, are published for public information and discussion. They will serve a "Metropolitan Transit District," extending out for about forty miles from the city. The Commission estimates that, six years from now, the proposed district will contain about 10,500,000 people, of whom 3,900,000 will be suburbanites; and that in 1950 the population will be 17,000,000, of whom 7,000,000 must depend upon the proposed Metropolitan Transit System for getting to and from New York City. To accommodate this enormous suburban traffic it is proposed to provide a separate and independent collecting and distributing system, traversing central Manhattan, for the exclusive use of suburbanites now served by the steam lines. The new system will be composed of three lines. The first will run from Jamaica to the Battery; up the west side of Manhattan to a new super-street built between Ninth and Tenth Avenues to 59th Street; and then below the East River to Long Island. The second, a Westchester-New Jersey line, will extend from 149th Street, in the Bronx, under a new super-street between Third and Second Avenues to 58th Street; thence with two branches, one down the Bowery and under the Hudson River to Johnston Avenue, Jersey City, and north through Jersey City, to return to Manhattan at 59th Street; the other proceeding across 58th Street to a new super-street between Ninth and Tenth Avenues and thence south as shown on the map. The third will be a New Jersey line, routing from the West Side and Sip Avenues, Jersey City, south under the hill and Johnston Avenue; under the Hudson to the Bowery, and north by the Westchester and New Jersey line to 57th Street, thence west under the Hudson to Weehawken and thence south as shown. Thus there is provided a double-loop, entirely new and independent system, bringing suburbanites directly to their business offices. This is the outstanding feature of the system. If a 100-seat car be developed, 245,000 seated passengers can be carried in one direction during the rush hours. The two new super-streets, which will be double-decked, will be cut through the existing blocks and will add thirty-six automobile traffic lines to the existing north and south lines in Manhattan. The new streets will be 120 feet wide.

SUPER-STREETS AND SUBWAYS: TENTATIVE DETAILS OF A TRAFFIC PLAN RECOMMENDED FOR NEW YORK CITY

The West Point Military Academy

Our Democratic School of Arms, Whose Motto Is "Duty, Honor, Country"

ABOUT two hours after leaving New York on one of the day line steamers of the Hudson, and on rounding a bend where the mountains begin to close in upon the river, the traveler is startled by the vision of a great medieval fortress which carries him back in thought to those majestic, architectural survivals, which so frequently crown the hills and frown upon the rivers of old Europe. Upon inquiry he will learn that these towered and battlemented buildings represent the latest addition to one of the most — perhaps the most — famous military academies in the world: West Point. From both the military and the scenic point of view the site is most admirable. The buildings stand upon a tongue or plateau of land, which juts out from the enclosing range of mountains, and they are dominated by the cathedral-like Cadets' Chapel, and by Fort Putnam of revolutionary days, which stands upon the very summit of the mountain and looks down upon the reservation from an elevation of several hundred feet.

The War of the Revolution left behind it many centers of profound historical interest, and among these West Point, because of its commanding, strategic situation and its close association with George Washington, stands preeminent. Washington and his staff early recognized its military value, and Fort Arnold was commenced in 1777 on the extreme eastern tip of the plateau, and Fort Putnam on the summit of Mount Independence. Furthermore, to block the passage of the British warships, the river at its narrowest point was closed by means of a chain or boom. The most interesting war-material relic to be found today at West Point is a length of this chain, which forms part of an exhibit of historical cannon and other military material that has been gathered at Trophy Point. About this time, in 1778, General Burgoyne moved down Lake Champlain and Lake George, in the endeavor to join hands with Sir Henry Clinton coming up from New York, with the idea of completely separating the American forces and their sources of supply and defeating each half in detail. But General Burgoyne was captured, and although Clinton's forces seized Mount Independence and routed the Continental troops, he returned to New York and the effort to seize and hold the Hudson River failed. Thereupon Washington directed that the fortifications and defenses at West Point should take precedence over every defensive effort along the Hudson and elsewhere.

After the war West Point was used as a military post for a few years; but in spite of the repeated efforts of Washington to establish a military academy, it was not until the year 1802 that Congress authorized its formation for the instruction of cadets of the engineer and other branches of the army.

The foundation of the academy upon the lines which have made it so successful and famous is due to Major Sylvanus Thayer, who became superintendent in 1817, and during his eighteen years of administration established the organization and spirit of West Point as we know it today. In recognition of his services a statue to Thayer was erected within the reservation. The fundamental features of the Thayer organization are the Honor system, under which the moral and ethical conduct of the cadet is governed by the cadets' interpretation of what it means to be at once "an officer and a gentleman"; the giving of daily marks on each recitation and the publishing of these marks; the formation of the cadets into technical units; the West Point system of discipline; the length of the course; the entrance requirements, and other important features. Under him the academy acquired that reputation for honor, patriotism and thoroughness which has ever since been maintained. In 1802 when Congress authorized the academy, there were but ten cadets under instruction; today it carries a maximum of 1344 on its rolls.

The story of West Point may be written from four standpoints—the architectural, the military, the educational, and last, and in our opinion, most important of all—the ethical, which is summed up in the inspiring motto of the academy, "Duty, Honor, Country."

Of the architectural features it is not necessary, nor have we sufficient space, to say very much. The glorious site, with its broad, grass-covered parade grounds, tree-embowered, flanked by stately buildings, and backed up by the heavily forested hills, speaks for itself, and no better view could be presented than the airplane picture which is shown on this page. Nor will anyone dispute the wisdom and good taste of the architects, Cram, Goodhue and Ferguson, in selecting a modified form of Medieval Gothic for the extensive building which became necessary a few years ago to house the ever-enlarging body of cadets. Fortunately, the earlier buildings are of a character that harmonizes well with these stately fortress-like constructions. Fort Putnam, grim and massive, crowns a hill upon the side of which is the magnificent Cadets' Chapel, of which a visiting western Congressman exclaimed to the conducting officer: "Chapel! Why, sir, this is no chapel, it's a full-blown cathedral." The Cadets' Chapel is, indeed, a veritable battle abbey and carries a strong suggestion of the chapel of St. George at Windsor. It is rendered glorious by its massive piers spreading out far overhead into a stone-vaulted roof; by its vast memorial windows at the east and west ends, and by the ragged battle flags, eloquent of many a hard fought engagement in our military history.

Rising sheer from the river is the Riding Hall, the largest in existence. On the opposite side of the driveway are the Academy buildings, and here also we find the Library, with memorials to Whistler and Poe, former West Pointers, and other memorials to many of the world's distinguished military men. Opposite the Riding School there towers up the castellated mass of the Headquarters Building, with its great Keep-tower, 14 stories in height.

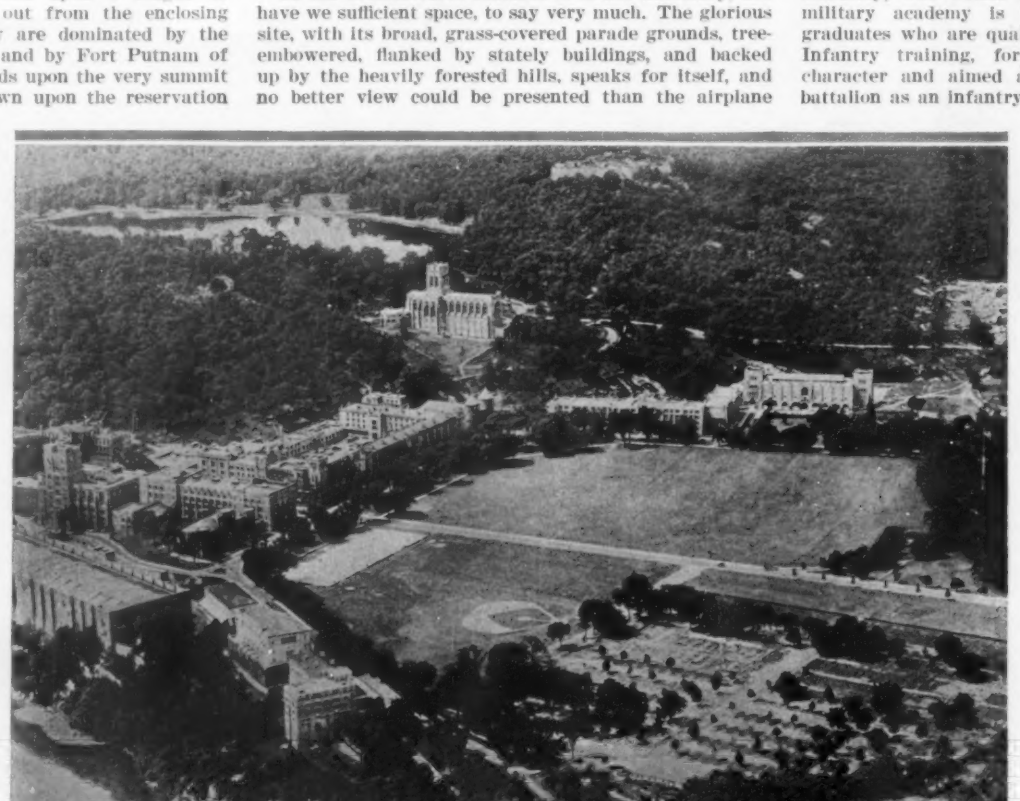
Rivalling the Library in age is Grant Hall, where the cadets have their mess. To the west of the Academy buildings are the two quadrangles of the Academy Barracks, containing 451 rooms. He is a poor American, destitute indeed of both sentiment and historical sense, who can wander around West Point and not be uplifted by memories of Grant, Lee, Sherman, Sheridan, Stonewall Jackson, that abound within its buildings.

Turning to the purely military side of the West Point course, we cannot do better than quote Major-General Fred. W. Sleighton, superintendent of the Academy, who writes in the *Infantry Journal:* "The military academy is now charged with producing graduates who are qualified to lead a platoon. . . . Infantry training, formerly largely disciplinary in character and aimed at the perfection of the cadet battalion as an infantry rifle unit, now covers the manipulation and technical use of all the various infantry weapons." This enlargement of the military training is obviously due to the remarkable development in military material which took place during the war. All the cadets are made familiar with the construction and the technical use of machine guns, field guns, and Howitzers, light and heavy. At stated periods they go in classes to one of our coast defences and are trained in the use of coast-defence guns of the largest caliber. That this training is highly successful will be acknowledged by anyone who has seen the cadets on parade, in camp or engaged in drill with the weapons and artillery above mentioned.

The summer months are spent by the cadets under canvas in what is known as the Summer Camp, a section of the reservation adjoining the Parade ground and not far from Trophy Point. The instruction program is very comprehensive, consisting in a practical application of the theoretical instruction that has been given during the preceding academic year. Thus, for the first class there is infantry combat, with emphasis on troop leading; signal communication, field engineering, field artillery, and so forth. Attacks are made as in actual warfare and include the meeting engagement, occupation of position, organization of position, etc., in which service rifle, machine gun, one-pounder, and field artillery ammunition are used. In fact, the cadets are put through as near an approach to real war operations as peace time can allow.

A book could be written on West Point's activities; but within the compass of this article we can do no more than give an outline sketch of the third section of our story; namely, the course of academic education. And, at the outset, let it be understood that West Point is no mere high school or private academy; as a matter of fact it is an institution of full college grade. A cadet must be seventeen years old, and his mental qualifications must be those required at entrance to a first-class college; the course is hard and calls for full mental and physical effort on the part of the student. In his first year, for example, he is in the section room from 7:55 A. M. to 9:20 A. M.; at the gymnasium from 9:20 A. M. to 10:10 A. M.; at study in his barracks room from 10:10 A. M. until 12 noon; at study again from 2 P. M. until 3 P. M.; at drill from 3:15 P. M. until 4:15 P. M., except Wednesdays and Saturdays. He has time to himself for recreation and exercise from

(*Continued on page 219*)

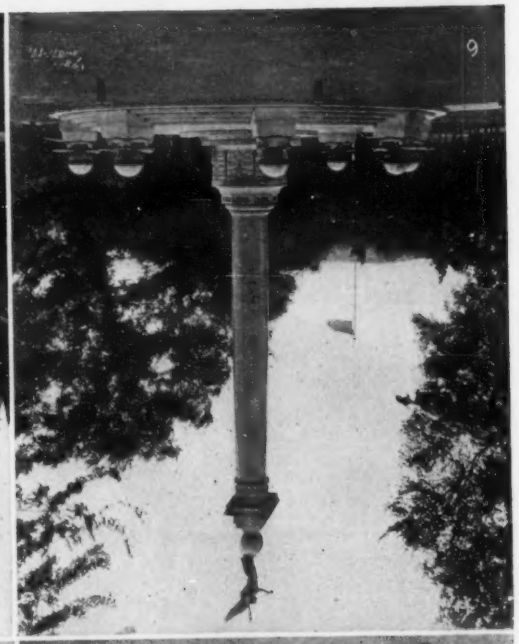


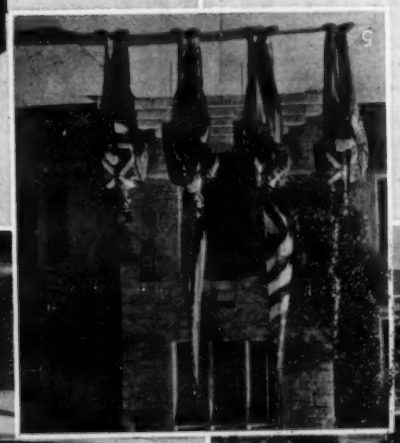
The further half of the center plain forms the Parade Ground; in the foreground are *(left)* the Sports Field, *(right)* the Summer Camp site. At the top of the hill is old Fort Putnam (built by Washington), below are the reservoir and the Cadets' Chapel. To the left of the plain are the Administration Building and the Academy buildings, and back of them the great quadrangular Barracks. Beyond the plain are seen the North Barracks and the Gymnasium. In the foreground are the Riding Hall, the Officers Mess, Cullum Memorial Hall and the Officers bachelors' quarters

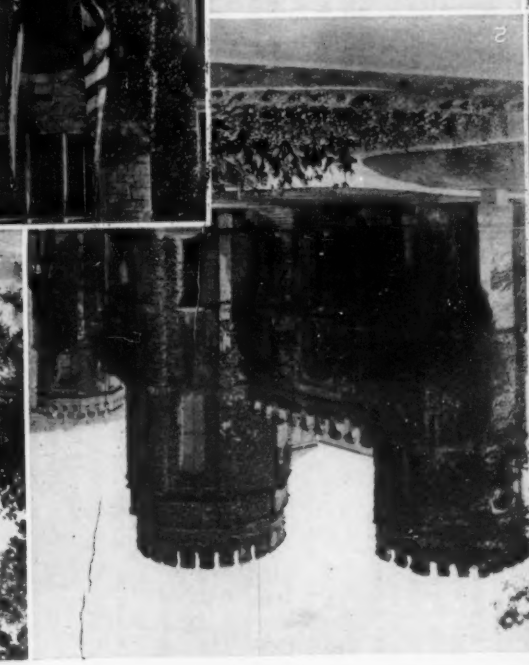
Our well-known military academy at a glance: Airplane view of West Point

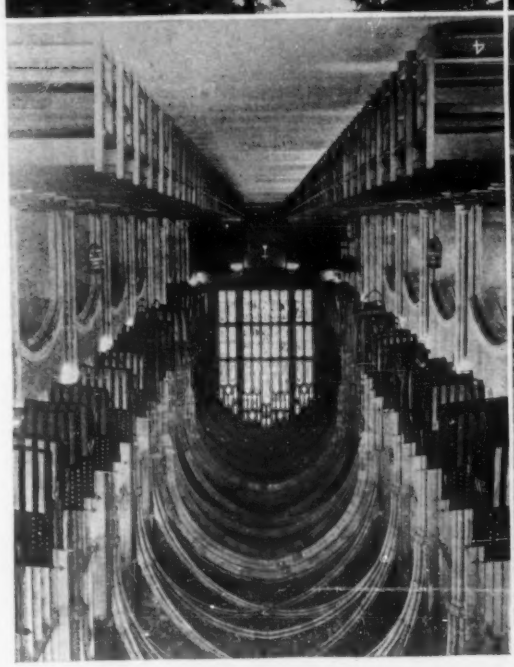
OUR ARMY OFFICERS IN THE MAKING: A FEW OF THE STATELY WEST POINT BUILDINGS

1. In the foreground is the old Academic Building, with the new Academic Building nearby. In these the cadets are given instruction by Army officers who are detailed to the Military Academy for a four-year period. 2. The Library, although it is one of the older buildings, is greatly admired for its architectural excellence. Built in 1841, it is the oldest building on the Post for the use of the cadets. 3. In the foreground is the Post Headquarters, one of the finest of the new buildings; built of granite and concrete in the Gothic style. It is heavily panelled and enriched with carved shields and emblematic sculpture. 4. The Cadets' Chapel. This stately Gothic church is perhaps the choicest among the many handsome buildings with which West Point has been enriched. It is modified Gothic (Cram-Goodhue-Gothic, we had almost said), and is one of the most successful efforts of those gifted architects. The church lifts its fine nave and noble tower above the woods of the mountainside and dominates the Academy grounds. The lofty grotned roof, rich memorial windows, and tattered battle flags combine to make a beautiful and impressive interior. 5. The Colors. 6. Battle Monument. This handsome granite shaft is situated on Trophy Point, where a lovely view is had of the Highlands of the Hudson. It commemorates the officers and enlisted men of the United States who lost their lives in the Civil War. 7. These picturesque "Quarters" forming part of the recent enlargement of West Point, front on the Hudson River. 8. The Post Headquarters, with its battlemented tower and the entrance gateway below, is a most impressive structure of medieval character. The gateway wall joins this building to the new Riding Hall, the largest in existence. 9. Among the ancient trees of Trophy Point is a part of the iron chain which was stretched across the Hudson during the Revolution, to prevent the passage of warships. It was forged out of two-inch bar iron and is in good condition. Here also are historic guns captured during the various wars in which the United States has been engaged.





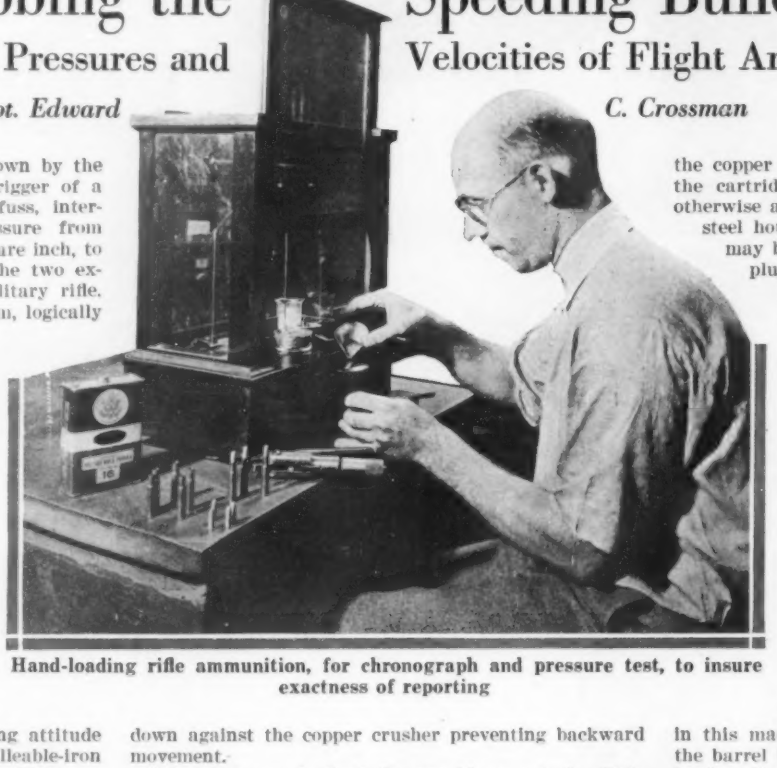




Tabbing the Speeding Bullet

How Powder Pressures and Velocities of Flight Are Measured

By Capt. Edward C. Crossman



Hand-loading rifle ammunition, for chronograph and pressure test, to insure exactness of reporting

THE FACT is not generally known by the proletariat that pulling the trigger of a loaded firearm results in a fuss, internally, which ranges in pressure from eight thousand pounds per square inch, to fifty-five thousand pounds. The two extremes consist of the shotgun, and the military rifle.

The humble and inoffensive .22 calibre arm, logically to be suspected of having the least fuss within its barrel chamber, develops considerably more pressure than does the shotgun, its variation ranging from ten thousand to fourteen thousand pounds per square inch, which means that it commences at a figure where the shotgun leaves off if the welfare of the shotgun user is at all considered.

Revolvers and pistols run through much the same gamut of pressures as does the little .22, the top figure of around sixteen thousand pounds being rather higher than the top figure for the .22, which would be given by the .22 Long Rifle Smokeless.

It is this fact that a revolver cartridge may develop an outward pressure on the chamber walls and breech mechanism of as much as eight ordinary tons per square inch, that is responsible for the disapproving attitude of the gun-familiar person toward these malleable-iron and cast-iron foreign pistols and revolvers which proceed from Spain, Portugal, Germany, Belgium, Madagascar, Timbuctoo and way stations, to be advertised and dispensed by irresponsible one-horse "importers" to those uninformed and incautious persons reading the advertisements. A count of the advertisements in the pages of one cheap country-circulation weekly paper developed 16 advertisements of these cheap pistols and revolvers, sold by eight different "importing companies" with names in inverse impressiveness to the real importance of the firm. This is not to insinuate that all imported pistols and revolvers are cast iron or dangerous, but it is to allege with considerable emphasis that about 90 per cent of the different varieties are dangerous and unreliable.

Because of the disruptive pressures that might easily develop in the chamber of a firearm, and because of the strenuous competition among American arms and ammunition companies which demands uniformity of load and accuracy of result, the finest of scientific apparatus is used by our powder and ammunition and arms companies.

Probably the least scientific is the arrangement for taking chamber pressures, which records final pressures by the simple method of measuring the amount a copper rod is compressed, but which unfortunately cannot tell us anything as to the speed at which this work is done. Inasmuch as the job of a charge of powder in the breech of a gun is to work at pushing the bullet or shot charge down the bore, the method of working has some bearing. The copper crusher in the pressure gun merely says that a maximum of 50,000 pounds or so existed in the chamber but does not say whether it happened gradually or like a blow—an explosion or a detonation. One can open a heavy swinging door by a push, or one can put the same energy into a blow, but the result in one case is a rather gentle opening of the door, in the other a crushed panel and a battered fist.

In spite of this imperfect method, nothing better has been evolved. Therefore the ballistic gentlemen find out how high the pressure is running in the chamber of a gun by boring a hole through the barrel wall at right angles to the bore, and at the point of highest pressure, or not far from the shoulder of a bottle neck cartridge. In the bottom of this, about 1/20 inch in diameter, is pushed an open copper cup to act as a gas seal, and above this is inserted a little section of steel rod closely fitting the hole, and called the piston. Above this is the "crusher," another short section of rod but made of copper. A thrust block, held in a housing firmly fixed to the barrel, is screwed down against the copper crusher preventing backward movement.

When the gun is fired the gas blows out the little circular section of cartridge case opposite to the piston in the hole drilled through the chamber wall, and then drives the steel piston outward, compressing the section of copper rod between piston and thrust block. Inasmuch as the length of the crusher was carefully measured before being inserted into the pressure gun apparatus and as the force necessary to shorten it is determined by actual test in a machine for each lot of crushers, its change in length as shown by a pair of micrometers is easily converted into pounds per square inch by reference to a table. By drilling a number of holes along the barrel the pressures may be taken simultaneously at these spots and so a curve of the pressure within the length of the bore, neatly plotted from the figures so obtained.

Shotgun testing requires, as a rule, the use of a lead crusher instead of the copper, the pressure of from three to five long tons not being sufficient to make much change in a copper crusher. Low pressure cartridges such as those intended for use in pistols, are usually drilled before being inserted into the pressure gun, the hole through the case, of course, carefully registered with the hole in the barrel through which the gas is to escape and move the piston.

The British do not always use our "side-piston" system of measuring the internal bore pressure. For taking the pressure of high concentration rifle cartridges, such as used in military rifles, they often rely on the "Woolwich" or oiled-case system. With this the copper crusher is breeched up directly in rear of the cartridge case, and the barrel is not drilled or otherwise altered. The barrel is screwed into a strong steel housing, arranged so the breech of the barrel may be closed by a circular wedge system with a plug screwing up and holding the assembly. The cartridge is dipped up to the neck in a light oil to eliminate friction against the walls of the chamber, and is then inserted into the chamber. Back of it is placed a hollow piston and in rear of that the copper crusher, a thick copper disk with hole through it to permit of the passage of the firing pin. With the whole assembly firmly breeched up, the firing pin is released and moves forward through the perforated crusher and piston, and fires the cartridge. The case moves back under the gas thrust and compresses the copper crusher through the agency of the piston in rear of the case.

The advantage claimed for this type of pressure apparatus is that by means of various bushings turned up to fit the threaded portion of the barrel, nearly any variety of rifle cartridge may be tested in this machine without destroying the usefulness of the barrel by drilling through it for a side-piston. It is also alleged that the case, moving rearward, gives a more correct picture of what is transpiring within the chamber, than the side piston system in which the momentum of the piston has some relation to the figures obtained, and where the gas thrust is taken at right angles to the normal movement of the waves.

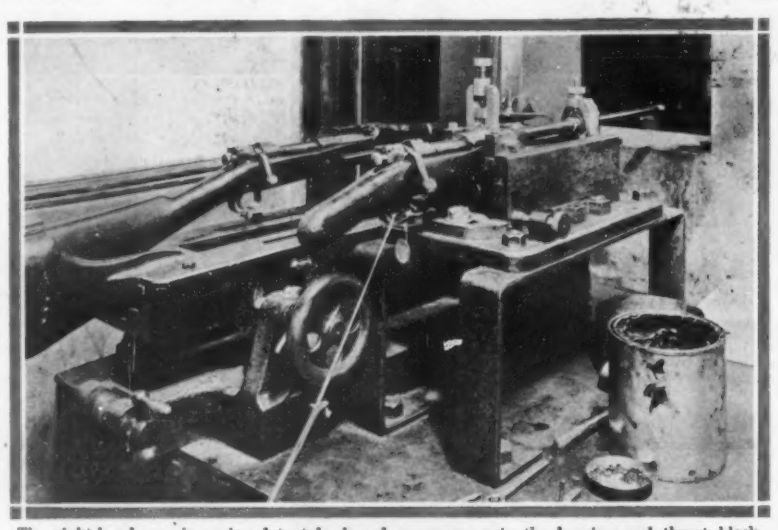
Taking the pressures of a cartridge is a comparatively simple mechanical operation compared with the equally interesting question as to how fast the bullet or shot charge may be traveling. Very early experimenters, back in the days of black powder and slow-going spherical projectiles, found that neither Grandfather's silver watch nor yet the much more refined stop-watch imparted much information along these lines. So far as anybody could see, over short ranges at least, the missile traveled like the charge of shot from the colored person's gun, of which he alleged "no sooner did it start than it was there."

The apparatus finally evolved has been in use for a half century, and improved only in detail, not in original scheme. This, the Boulengé, improved by Colonel Holden of the British Army, measures the time required for the bullet to travel over a given distance, about 150 feet in American practice, by the fall of a heavy weight, released at the time the bullet leaves the muzzle of the gun. As the time taken for the weight to fall a certain distance is easily put into table form, the bullet time is read directly from the table showing distance fallen in terms of time.

The machine, known as a chronograph, makes use of two heavy rods, tipped with iron, and held suspended by two electromagnets. It is probably not necessary to remind the reader that when the current passing through an electromagnet is interrupted, the magnet ceases to be of any attraction to steel or iron.

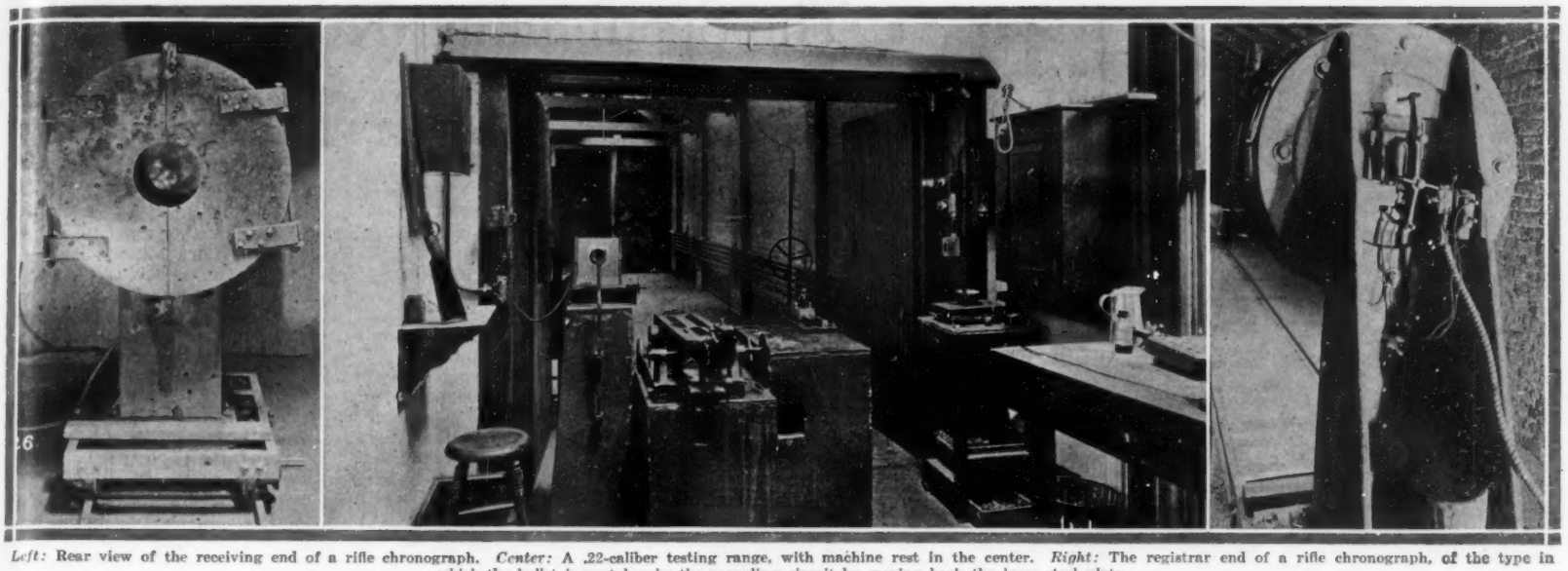
The first or chronometer rod is usually encircled by a zinc or leaden sleeve, and is held by an electromagnet connected with a wire stretched across an insulated frame at the muzzle of the gun. The second or registrar rod is held by a magnet connected with a network of wire or a steel plate easily moved to break the current, and located at the farther end of the measuring range. Below this rod is the trigger of a spring-impelled knife, which if released, springs out and strikes the chronometer rod, hanging close to it. When the registrar rod falls, it releases this knife and it springs violently forward.

When the gun is fired, the bullet breaks the wire and the circuit of the magnet holding the chronometer rod, and it promptly commences to fall. When the bullet has sauntered down the 150 feet or so of the range, it encounters the steel



The right-hand gun is equipped to take breech pressure; note the housing and thrust block. The other is set up for barrel pressure

Determining the powder pressure inside the gun



Left: Rear view of the receiving end of a rifle chronograph. *Center:* A .22-caliber testing range, with machine rest in the center. *Right:* The registrar end of a rifle chronograph, of the type in which the bullet impact breaks the recording circuit by moving back the loose steel plate

Some details of the chronograph outfits that take the time of the speeding bullet

plate or wire network of the circuit controlling the second or registrar rod, which being released, also falls hurriedly, striking the trigger of the knife which reaches viciously out and makes a nick in the soft sleeve of the chronometer rod which is even then hastily falling past the knife. Inasmuch as the zero mark had been registered beforehand, showing the position of the knife blade before the chronometer rod started to fall, the distance between this and the nick made in the falling weight represents the time required by the bullet to travel down the range. The lag in this series of events is found to be so slight as to have no significant influence upon the results—which is one very good reason why the same design has been used for so long with so little change.

The old form of chronograph made use of a network of wire running from insulated pegs, at the receiving end of the range, which, being cut, permitted the second or registrar rod to fall. American factories find this too slow in practice, and make use of an easily moved armor steel plate, which on being walloped by the bullet, moves back, breaking an electric circuit and thus permitting the registrar rod to fall. The only replacement, therefore, from shot to shot, is merely drawing out a little more fine copper wire from its spindle, and winding it across the two insulated pegs in the frame at the muzzle of the gun. This takes much less time than replacing the wire net.

The distance that intervenes between the zero nick and the registrar-rod nick on the sleeve of the chronometer weight, translated into fractions of a second, means, of course, the entire time taken by the bullet to travel the range length, which may be 100 to 180 feet, depending on the type of ammunition being tested. This is easily converted into feet per second, which is our standard, the average velocity over the distance being taken as the actual velocity at half-range. The actual muzzle velocity is calculated and depends on the ballistic coefficient of the bullet and the velocity.

The shotgun is a type of weapon not lending itself to the nice and exact methods of velocity measurement possible with the single projectile. Its pellets insist on traveling in a considerably elongated procession, a parade which, with 7½ shot, is 12 feet long at a distance of 40 yards from the muzzle, although the entire charge from a full choked gun could be contained in a circle three and a half feet in diameter so far as lateral dispersion is concerned.

As the first pellet is a dozen feet in front of the last pellet, it would be obviously misleading to permit the leading pellet of the charge to break the registrar circuit at the farther end of the range.

The circuit-breaking plate, therefore, is usually set up with enough spring resistance to require the impact of about 20 per cent of the charge to drive it backward and break the registrar circuit.

American factories, queerly enough, take their shot velocity over a range of 120 feet—40 yards—which is longer than the average range of the bird shot in the field, and nearly as long as the average range of the wild-fowl actually killed by our gunners. It is, of course, not at all so long as the range stated by the gunner when he later recounts the tale of the killing of the duck or what-not.

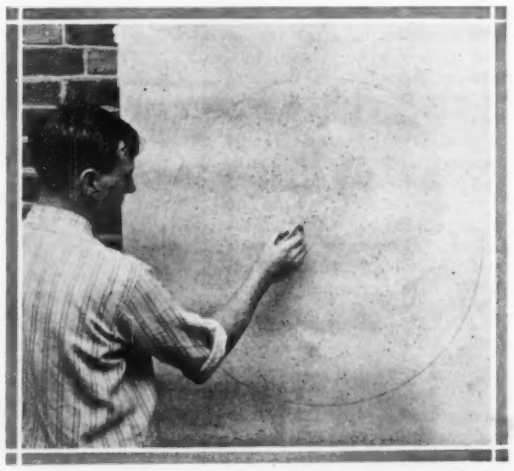
This would be about equivalent to taking the velocity of our rifle bullets for killing game, at about 250 yards. Neither the shotgun figure, nor the figure thus obtained for the rifle bullet if we did it this way, would bear much relation to the actual muzzle speed.

Shot falls off very rapidly in velocity, due to spherical form, light weight, and the air resistance thus poorly overcome. The charge of No. 6 shot, probably the most common of shot sizes, which leaves the muzzle with a speed of 1350 feet per second, arrives at the 30-yard mark minus just half of this original speed, and at the 40-yard distance has but 41 per cent of the original speed. At 60 yards, the outside limit of practical wild-fowl killing, the shot has but 27 per cent of the speed at which it left the gun.

This is sufficient to make clear that common American shotgun ballistic figures for shot speed, mean little as to actual muzzle velocity; they pertain merely to the mean speed of the charge over an average game-shooting distance, which means the actual velocity at half of this distance—20 yards in our system. When the ballistic gentlemen inform the shooter, therefore, that a charge of 7½ shot used for clay bird shooting has a velocity of 840 feet per second, and that a charge of No. 4 shot at high speed for wild fowl shooting has a velocity of 1000 feet, they mean that the charge had a muzzle speed in the first case of about 1250 feet per second, and in the second case of about 1500 feet.

The British take their velocity over 20 yards instead of 40, and their velocity figures, therefore, run around 1050 feet, all of which is considerably puzzling to the uninitiated person who might be led to believe that British ammunition was much better than ours in view of its higher speed.

The chronograph, as with the patterning paper or plate showing the final distribution of the shot pellets, is a gay deceiver as to the actual performance of the charge in flight. "Stringing," or the forging ahead of faster pellets and the lagging of others, is shown only by special apparatus, such as revolving disks which register differences in time of arrival by different spots on the disk, or by the Belgian La Chaussee chronograph, of which there is but one specimen to be found in this country.



Counting a shotgun pattern made at forty yards, to indicate the dispersion

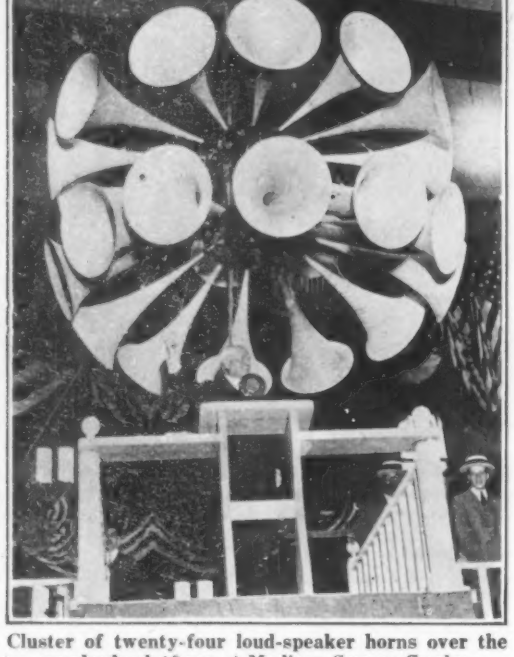
In this apparatus the face of the machine is covered by stationary sheets of white paper, sufficiently large to show the entire spread of the charge, and covering three windows in the steel column forming the support for the apparatus. Inside of the column, and slightly in rear of the paper covered windows, is a falling member, also covered with paper, one single sheet extending far enough to equal the space of the three paper-covered stationary windows. This falling member is held by an electromagnet with its circuit passing through a wire stretched across the muzzle of the gun. The shot breaks the circuit, and the paper-covered falling member drops in its grooves parallel with the paper-covered windows in the face of the machine. The shot pellets perforate the first stationary paper coverings and then the paper-covered falling member behind them.

The operator then raises the falling member until a shot hole in the stationary paper-covered window and in the falling paper-covered member, precisely coincide. The distance is then measured from the poles of the magnet to the armature of the falling member, which represents the distance fallen by the sliding member while that particular shot pellet was traveling up the range. If the shot charge traveled all in the same plane transverse to the line of flight, all of the shot holes in the stationary windows and the paper-covered falling member should coincide when the obvious coincidence of any one pellet had been found. If they do not coincide, then the difference obtained in distance is easily translated into velocity, and the stringing of the charge easily translated from this table of velocity differences for the various pellets.

This is the only known device for giving individual pellet velocity for the various portions of the charge—top, bottom, and center, although, of course, not for every pellet of the charge, which might range from 150 to 500 in number.

Our own military service uses at times an improved type of chronograph known as the Aberdeen from the proving grounds developing the instrument. Here the recording portion consists of a revolving pan driven at high speed by an electric motor. Within the inner periphery of the pan is a strip of sensitized paper. Two electric terminals are placed at practically the same spot and close to the revolving pan, but operate on two entirely different circuits, one of them passing through the wire at the muzzle of the gun, the other being located at the farther end of the chronograph range.

When the shot leaves the muzzle of the gun, a circuit is closed, and a spark leaps from one of the terminals through the sensitized paper, to the rim of the revolving drum or pan. When the bullet strikes the farther end of the range, another circuit is closed, and another spark leaps from the second terminal through the paper. As the drum revolves at a known speed, the distance from one spark to the other indicates the time lapse as the bullet travels down the measured distance.

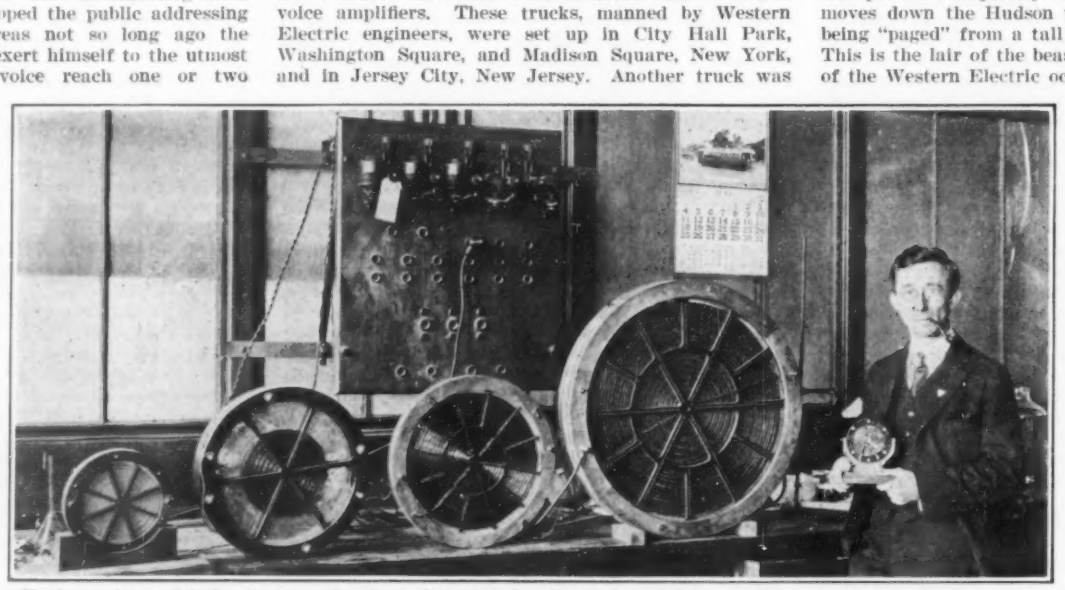


Cluster of twenty-four loud-speaker horns over the speaker's platform at Madison Square Garden

The Spellbinding Kilowatt

Microphones, Amplifiers and Loud-Speakers which Enable the Human Voice to Reach Vast Multitudes

STEP by step with radio broadcasting there has been developed the public addressing system. Whereas not so long ago the orator had to exert himself to the utmost to have his voice reach one or two thousand persons in a large auditorium, today, that same orator, without raising his voice above a conversational tone, can make his voice heard by tens of thousands of people indoors, outdoors, in this particular city or anywhere else. Indeed, the speaker may be in New York, speaking in a large auditorium, yet his voice will be heard in the public parks, in Washington, in Boston, in Chicago — anywhere, in fact, if what he has to say is of sufficient importance. All of which is due to putting kilowatts of electrical energy into that speaker's voice, and having numerous loud-speakers face the far-flung listeners.



Various sizes of induction-type loud-speaker, ranging from the smallest for home use to the large one for outdoor audiences, in the laboratory of Dr. C. W. Hewlett

In newspaper stories of both the Republican and the Democratic National Conventions, comment was frequently made on the careful attention paid to the speakers and the lack of "milling around" in the balconies during speeches. The reason, not always appreciated, was that the entire audience, even in the farthest seats, could hear plainly. This great improvement over former conventions was due to the system of voice amplifiers installed for the two events. An equally impressive feature was the large and orderly crowds outdoors who listened intently to the broadcasting of the convention, as it was picked up from the air and put out through portable amplifying outfits.

For both of the conventions the amplifying outfits were similar. On the speakers' platform were placed two or more microphones, enclosed in the circular housing which has become so familiar in pictures of radio artists. These were connected over independent circuits to the amplifying apparatus behind the scenes. The latter comprised a four-stage vacuum-tube amplifier, with the necessary power supply and control switches. That the amplifier is far more powerful than anything the most advanced radio fan has hooked up may be gathered from the fact that its last stage uses four 50-watt tubes connected in push-pull, and supplied with direct current at 800 volts. An interesting adjunct, and one of great importance to the audience, is the volume indicator, a device employing a single vacuum tube and a galvanometer whose swings indicate the volume or "loudness" of the output current. Since overloading the amplifier produces unpleasant distortion of the sound, the operator watches the jumping needle constantly and when it threatens to go beyond a certain point he reduces the amplification accordingly. By giving more increase to weaker voices, he more or less "levels off" the speakers' ability to shout, and hence indirectly puts a premium on what is said rather than on how loud it is said.

High over the platforms hung a group of horns—12 in Cleveland, 24 in New York—looking much like the trumpets which are supposed to be part of the heavenly angels' equipment. These are wired in groups to the amplifying apparatus. Installing and testing out the equipment, which was done by engineers of the Western Electric Company, was no mean job; several thousand feet of wire had to be run, much of it in flexible conduit. To secure the proper volume of sound in every part of the hall, observers were stationed in the audience, with field telephone sets over which they could talk to the man at the controls. All the apparatus was duplicated, so that a failure anywhere would interrupt the service only so long as it took to throw a switch.

The equipment used outside for the benefit of the general public was even more significant to a student of politics. In the New York district alone were four motor trucks on which were mounted radio sets and voice amplifiers. These trucks, manned by Western Electric engineers, were set up in City Hall Park, Washington Square, and Madison Square, New York, and in Jersey City, New Jersey. Another truck was used in Cleveland. Originally designed for stump speaking, these trucks carried a tail-board large enough for a speaker's platform and a folding mast with a cluster of horns. The outfit used in Washington Square carried a four-stage vacuum-tube amplifier, and six horns; while the other trucks had three-stage amplifiers feeding four horns. Storage batteries furnished both filament and plate current. Microphones on the platform enabled local announcements or speeches to be made, had they been desired. One of these outfits was loaned by Colonel E. H. R. Green, who will use it in and about New Bedford this summer to receive radio programs broadcast from his own station, WMAF.

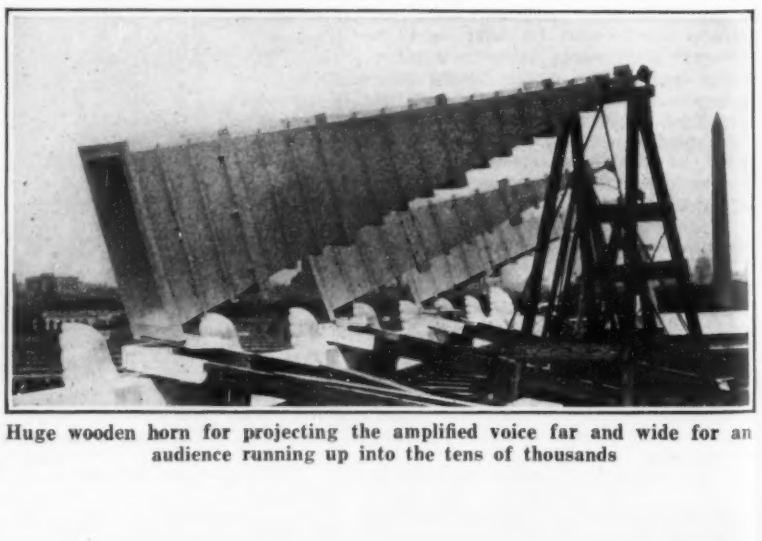
These trucks and others in the Western Electric fleet have already played to large audiences all over the country. One of them has already logged more than 30,000 miles and has amplified the voices of President Coolidge, M. Clemenceau, Jack Dempsey, Eugene V. Debs, Governor Smith, Mayor Curley of Boston, and other notables. It is expected that all the trucks will be active in this fall's political campaign. The strain of speaking day after day to even small audiences, many times out-of-doors, has confined "stumping" to men of vigorous lungs, and has deprived the electorate of the hearing and seeing many of the candidates. With the smaller of the trucks, a speaker using only a conversational tone can be heard easily by 6000 people, and with the larger one by over 60,000. These are audiences worth anyone's while to address, especially when they can hear well enough to listen attentively to a worthwhile message.

Another loud-speaker development of the past year will be useful to candidates who travel in private Pullman cars. This comprises microphones in special housings on the rear platform, a four-stage amplifier inside, and compact horns fastened to the car roof. Such an equipment last summer enabled its user to address crowds at railroad stations several times a day with but little effort.

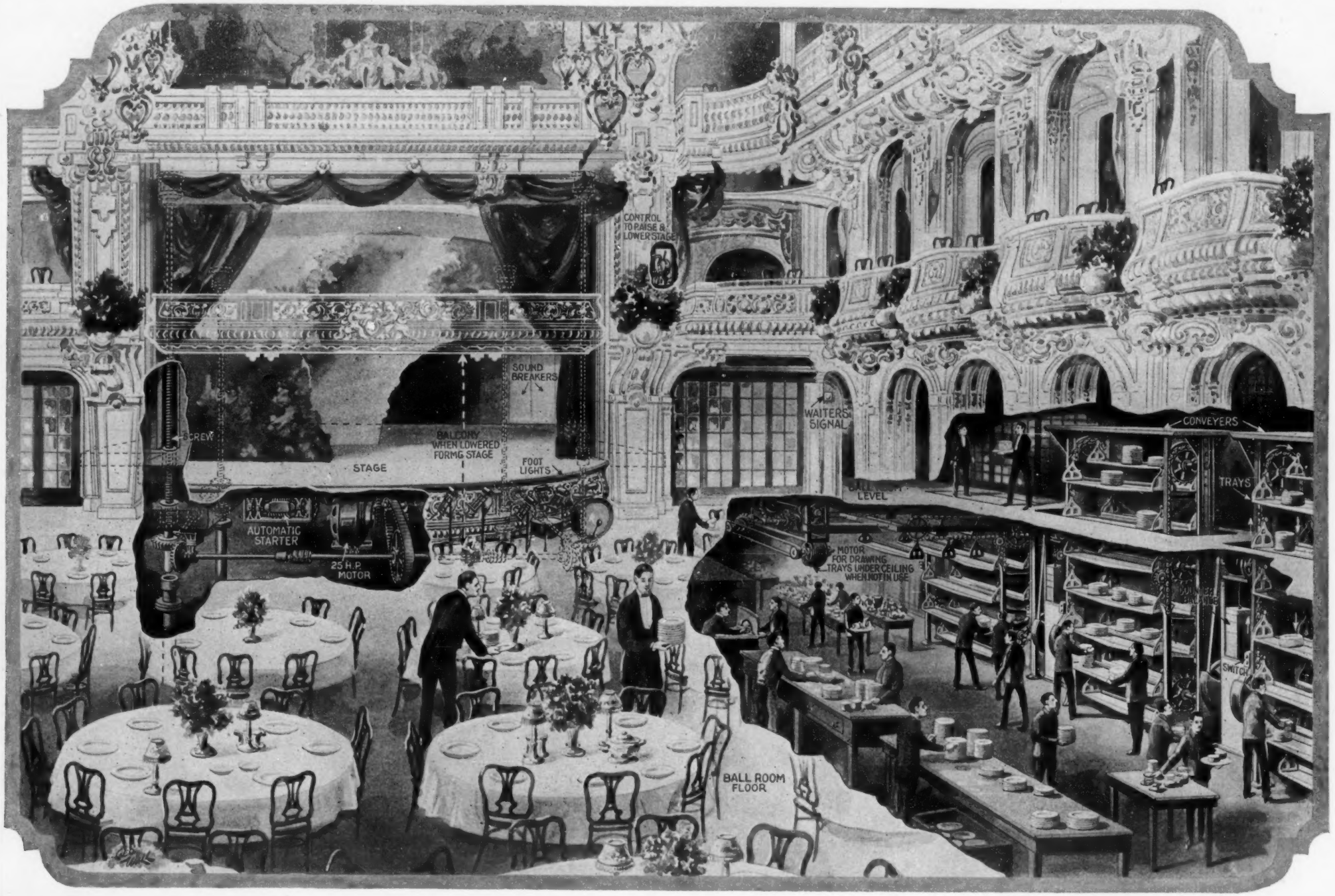
While loud-speaker design has so far limited itself to moderate throws, on several occasions long distances have been covered. In one of the early tests, music was projected over an intervening valley to observers 3½ miles away. Travelers leaving New York for Europe are frequently surprised, as their steamer moves down the Hudson to hear one of their number being "paged" from a tall building on the water front. This is the lair of the beast, so to speak, and engineers of the Western Electric occasionally use it to bid their friends good-bye in stentorian tones. The same company has installed one of the outfits in its big factory in Chicago, where it will be used to address mass meetings of workers both indoors and out.

The best known type of public-address equipment is available in three different sizes. The largest size employs four stages of amplification and gives an energy-gain of 19,000,000 times from microphone to projectors. This is suitable for the largest public auditoriums and outdoor gatherings. It is a permanent part of such places as Civic Auditorium, San Francisco, the Auditorium, Cleveland, the Municipal Pier, Chicago, the Coliseum, Los Angeles. The second size has also four stages of amplification, and is suitable for rooms up to 3,500,000 cubic feet. It has been installed in the Astor, Commodore and Waldorf-Astoria Hotels, New York, and the Copley Plaza in Boston; St. John's

(Continued on page 220)



Huge wooden horn for projecting the amplified voice far and wide for an audience running up into the tens of thousands



HOW it is possible to serve 2200 dinners at one time is shown in this drawing. It represents the Ball Room of the Hotel Astor, New York. The large Ball Room is on the main floor and is flanked by the Rose Room and the Laurel Room so that three separate banquets can be held with three separate orchestras without interfering in any way with each other, or all three may be thrown together for very large affairs. This is accomplished by the aid of padded sound breakers which absorb the sound that would otherwise penetrate from one big public room to the other. All three can be served from the same banquet kitchen by the aid of the mechanical food conveyors depicted in our illustration.

The capacity of the Ball Room is 1400 diners, and the Rose and Laurel Rooms 400 each, so here we have our 2200 diners. The food is prepared by the banquet-chef and his assistants as far ahead as is consistent with good culinary art, and then everything awaits the visitors who roam around the ample corridors and in the conservatory at the rear. The doors are opened, the orchestra is playing, the guests are rounded up and enter the beautifully decorated Ball Room, a signal is flashed below to the kitchen and, presto, up rise sections of the conservatory floor and up comes the food on the conveyors, the plates of oysters or the soup tureens, for the service is *à la Française* and everything is served from dishes passed by the waiters who, by the bye, never go near the kitchen at all. The carriers are driven by electric motors and rise and descend perpetually carrying the food and removing the used dishes. A special motor is used to haul the conveyors into position and raise the section of the floor. When not in use part of the conveyor lies under the floor as shown at the left. When the dinner is served the conveyor pulls the floor down and the departing visitors walk over the covered traps. Three carriers serve the main Ball Room and one each the smaller rooms.

Perhaps it is desired to give a little skit or a minstrel show. Suddenly a section of the gallery is seen descending and lo and behold, we have a complete stage with scenery, foot-lights and all accessories. We show how this is done. A 25-horsepower motor drives a shaft and imparts motion to four screws with the aid of bevel gears. There are no counterweights so there is no chance of the stage being hung up in mid-air. After the conclusion of the performance the stage rises and becomes a part of the gallery once more. The other people in the house have not gone hungry while the three societies have been enjoying their banquets. One thousand persons on the eighth floor and 2000 on the roof are served in special kitchens at this level while the five public restaurants feed a trifling 1800 more, so some 7000 persons can all enjoy a good meal at the same time thanks to machinery and efficient planning. The proprietor of the hotel was an electrical engineer before he was a Boniface.

SERVING 2200 DINNERS AT ONE TIME: THE ROLE OF ELECTRICALLY-DRIVEN CONVEYORS IN THE MODERN BANQUET HALL

Our Point of View

Round the World Flight

ALL honor to the Army pilots who, at the present writing, have covered over two-thirds of their flight around the world with a success which has already established this great venture as marking an epoch in the history of aviation. Even though some hazard of the North Atlantic weather should prevent the completion of the trip (a contingency which we do not fear), enough has been done to constitute this flight the greatest of all aerial accomplishments.

It should be clearly understood that the venture was no mere, daredevil, spectacular "stunt." On the contrary it was undertaken in a most serious spirit and for a definite and highly laudable purpose. This is shown by the brief official announcement made by the War Department, in which the purpose of the flight was described as follows: "To demonstrate the feasibility with which aerial communication may be established between the various continents and to obtain desired information concerning the operation of present type aircraft in various climates of the world."

Only the most captious critic would deny that these two major objects have already been accomplished. Three planes have crossed from America to Asia successfully, and this in spite of a succession of wind, sleet and snowstorms of great intensity. It is this feat which gives confidence that our fliers will cross the Atlantic from east to west, as surely as the British made the eastward passage a few years ago. As to the climatic conditions, they could not have been more varied, ranging from the cold and damp of the Alaskan seas to the fierce dry heat of the Mesopotamian lands.

The objects of the expedition, we repeat, have already been achieved.

Finally, we must not forget that the success of the flight is a great tribute to the endurance and technical skill of the army pilots, and to the reliability of that remarkable product of the war—the Liberty motor. Nor should we omit to mention the great advance that has been made in aerial navigation. The certainty with which the pilots made their way from point to point, speaks volumes for the maps, compasses and various special aids to navigation which have been developed during the past few years.

It would be both ungenerous and unjust to depreciate this great performance by pointing to the costly and elaborate groundwork that smoothed the way at the various landing places. This was pioneer work. When the commercial aviation for which the Army has thus paved the way is established, the aviator will be assisted by even better facilities than those which were extemporized for this pioneer flight.

The Super-Airship

IT IS well understood that, unlike the airplane, the airship gains relatively in useful load as its size increases, and herein lies the great promise for the future. The United States possesses in the "Shenandoah" the largest rigid airship in active operation. Before long in the "ZR-3" we shall have a ship still larger, with a capacity of 2,472,000 million cubic feet of gas. And now comes the definite announcement that the British government is lending the assistance of its treasury to a private company, which is to build two ships for service to India, each of which is to be over double the size of the "ZR-3" and have a gas capacity of 5,000,000 cubic feet.

At the last meeting in London of the Institution of Naval Architects, Commander C. D. Burney, in the course of a paper on "The Development of the Airship with Special Reference to Transport," gave some illuminating facts regarding the experimental work in the laboratory and shops and its results as applied to the designs of these huge ships. Briefly stated, the British engineers are adopting "a system for containing the gas bag, whereby no transverse load is imposed on the longitudinal girders, and the lift of the gas bag is collected and transferred to the transverse frames direct." The importance of this is understood when we remember that the weakest element in the rigid airship is the longitudinal girder, when it is subjected to compression. For it must be remembered that the compressive stress is increased by the fact that the gas bag exerts a transverse stress across these girders of considerable magnitude. The failure of "R-38" at Hull, England, was due to the combination of these two stresses, together with that imposed upon the girders by a sudden throwing over of the helm when the ship was running at high speed. If the British engineers have succeeded in throwing the lift of the gas bags directly on the circular frames, which are well able to take care of it, they have made a big step forward in the development of the art. Indeed, Commander Burney tells us that it is now possible to construct a commercial airship in which the factor of safety under the worst possible loading conditions will not drop below a minimum value of four, and that this can be done without any addition of weight.

Furthermore, improvements in stream-line form counteract the increased dynamic stresses and make it possible for these big ships to attain high speeds with about 75 per cent of the horsepower which would have been required three years ago. Also, realizing that the scarcity of helium would necessitate the use of hydrogen, attention was directed to the removal of the risk from gasoline, which is recognized as a greater source of danger than the hydrogen. Designs have developed by which a heavy oil such as kerosene with a high flash point may be used on a low-temperature cycle without loss of efficiency. Commander Burney tells us that they have an engine which weighs about six pounds per indicated horsepower, and is comparable in its mechanical simplicity and reliability with the modern steam engine of today. Experimental work is being done with a view to using still heavier oils such as the crude oil for oil-fire burners, and so well satisfied is he with the result that he ended his address with the statement that he could confidently say that the gasoline age for the airship in particular, and indeed for aircraft in general, has now virtually passed and we are entering upon an age when heavy oil fuels will be used without exception.

These super-airships will excite interest if only for their great dimensions and the new structural system adopted; but of greater interest will be the new heavy or semi-heavy oil engines which will drive them.

Rejuvenating the American Locomotive

THE distinction won by the American railroad is due primarily to its admirable freight service, which is entirely individual and distinctive. In this field, both as regards the size and power of the locomotives, the length and weight of the trains, and the low rate at which freight is hauled (low as compared with other countries), American railroads stand in a class by themselves.

Hitherto, our efforts have been devoted so closely to increasing the power of our locomotives that we have rather overlooked the question of their economy, with the result that the maximum efficiency of the fuel has been low and commonly rated at between five and six per cent. In other words, the locomotive has been considered an extravagant coal burner. But, while this was true from 15 to 20 years ago, for the past two decades there has been an increasing effort to improve the thermal efficiency of the locomotive. It will be news to many of our readers when we state that whereas the maximum thermal efficiency of a powerful locomotive on the Pennsylvania Railroad in 1904 was 5.13, in 1923 it had risen to 8.1. These facts were given at this year's annual meeting of the American Railway Association in a paper by Mr. W. H. Winterrowd of the Lima Locomotive Works, in which he showed that the great increase in recent years in the weight and capacity of our locomotives has been marked by a decrease in weight per indicated horsepower. Increase in size and the development of efficiency refinements have combined to bring this result.

Down through the years we have illustrated the various refinements looking to more efficient operation, which have been tried out both here and abroad, the most recent and striking of which is the building of turbine locomotives. At least for the largest locomotives, the turbine is not attractive to locomotive builders in this country, the great difficulty being the problem of condensing the large volumes of steam which have to be handled in locomotives whose total horsepower runs up to several thousands. Furthermore, let it not be forgotten that the maximum efficiency of the turbine is limited to a comparatively small range of its speed, and that the problem of reversing has yet to be solved.

Hitherto, our efforts in this country have been confined to the extensive use of high-pressure steam in cylinders. We have tried out the two-cylinder, the three-cylinder, and the four-cylinder compound, and today there are 600 locomotives of a special type in service, carrying 250 pounds of steam pressure, which have shown high efficiency. Their coal rates have been less than two pounds of dry coal per indicated horsepower per hour, and the minimum rate obtained was less than 1.75 pounds. This is as good, if not better than the rate in the average steam plant of the country. The elimination of back pressure by condensing has been widely studied in this country, but, as we have stated, no entirely practical solution has been developed. Good results are being obtained by using three cylinders to increase the capacity and efficiency of locomotives. The uniform turning torque makes for increased tractive effort, and the increased number of exhausts in the cylinder, by producing a more uniform smoke box vacuum, results in improved combustion conditions.

English Channel Tunnel Vetoed

THE PANAMA Canal, whose first ten years of service was celebrated last month, is one of three colossal engineering projects of the past 50 years, each of which aimed at the removal of a physical obstruction to transportation, at some strategic point in the flow of commerce. These three are the Suez Canal, the Panama Canal, and the English Channel Tunnel. The first named was opened in 1869; our own canal in 1914; but, according to the latest despatches, the last obstacle to the tunnel—opposition in the British Parliament—still bars the way, and the actual excavation of the long deferred Channel project is indefinitely postponed. Had Parliament consented, and assuming that the estimates of the French and British engineers are not over-sanguine, trains would have been running between England and France by the year 1930.

English opposition to the tunnel, which of late years has been rapidly decreasing, apparently, disappeared during the World War. This change of opinion was due, not merely to the mutual friendship of the two races as a result of their allied cooperation, but as much and perhaps more to the fact that the development of aviation has to a considerable extent robbed Great Britain of that insular protection upon which she relied for security. The military authorities, however, have again advised against its construction, and the Parliament has followed their advice.

Apart from the great commercial advantages which would grow out of the ability to despatch passenger and freight trains from Great Britain to any part of Europe and Asia there would be the abolition of the delay and miseries of the justly dreaded Channel passage, where, in certain moods, the wind and seas are able to put the passenger to more unmitigated misery than in any short sea trip on the face of the earth.

Here and There

BY curious coincidence, the same year that saw the death of Steinmetz, dean of the General Electric engineering corps, also put a period to the life of Benjamin G. Lamme, chief engineer of the Westinghouse Company, whose rôle as the mainspring of the Pittsburgh organization was closely analogous to the position held by Steinmetz in Schenectady. Mr. Lamme died on July 8th, after a lingering illness of several months.

BORN in Springfield, Ohio, in 1864, Mr. Lamme graduated from Ohio State University in 1888, taking his degree in mechanical engineering—in those days there was no such subject as electrical engineering and no such degree as E. E. Lamme, however, had developed a keen interest in this field and the year after graduation entered the employ of the Westinghouse Company. He went to this company at a time when little or nothing was known of the natural laws governing the industrial applications of electricity, and when the design of motors and generators was on the purely empirical basis of cut-and-try. To him a discerning superior assigned the task of developing the laws in question, and his success was one of the vital factors in giving the Westinghouse Company the position which it holds in the electrical industries.

THE most spectacular achievements of Mr. Lamme's 35-years service with the one employer were the designing of the World's Fair generating equipment for Chicago in 1892; the design of the electrical equipment for the first Niagara power project; the generating and motor equipment for the New Haven electrification, the first big railroad conversion from steam to electricity; the invention of the present-day single-phase alternating-current high-voltage system responsible for most subsequent railroad electrifications; the design of the most successful synchronous converter ever used; and the single-reduction-gear street-car motor, which though designed in 1890 is still the standard type used on street railroads. He was not a prolific writer; but what he did write was usually epoch-making. One of his greatest assets was his ability to get a physical conception of every problem, and he aimed always to give this in his paper. He seldom wrote mathematical papers, for he regarded mathematics as a tool which should be put up when the day's work was done; but he was a mathematician of conspicuous ability. He was a steady customer of Uncle Sam's patent office, his name being attached to over 150 issued patents.

IT is a hundred years since Lieutenant Matthew Fontaine Maury began those researches in oceanography which gave us our Pilot Charts and developed the ocean routes for sailing vessels and steamships which have saved untold millions of dollars to the commerce of the world. Now comes Captain Frederick B. Bassett, hydrographer of the Navy, with the proposal that the Navy fit out a vessel for scientific researches in the field of oceanography and marine geology. Captain Bassett, whose portrait adjoins, proposes a thorough and scientific collection of data conforming to the latest discoveries and studies in this field. It is pointed out that the newly developed sonic depth finder, invented by Dr. Harvey C. Hayes of the Navy, furnishes a ready means of rapidly determining depths of the ocean with practical accuracy, and now, as never before, the contours of the ocean bottom may be easily delineated. The Hydrographic Office of the Navy Department, of which Captain Bassett is the head, has made the preliminary studies for the organization of this scientific cruise. All departments and scientific institutions of the Government have been invited to cooperate with the Hydrographic Office in this monumental undertaking. It is anticipated further that scientists not connected with the Government may be called on for cooperation and assistance so that the combined resources of governmental and private activities may contribute and thus insure the success of the cruise.

Capt. Frederick B. Bassett

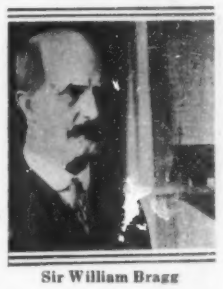
MOST of us are aware of the fact that, when Federal bonds or paper money is burned, the ashes may be sent to Washington and new paper will be issued in place of so much of the old as can be identified from these ruins. The immediate suggestion which comes from this fact is of an expert with a magnifying glass, poring over a box of fluff in the attempt to say how many and of what denominations were its original contents. This picture is considerably closer to the fact than the sophisticated pessimist might suppose. The lady of the annexed photograph, Miss Roberta L. Lindsey, is doing exactly the thing pictured. She is the foremost expert in the country in reconstructing burned bonds; and she is actually in the employ of the Federal Government, and not engaged in private practice, subject to retaining fees. It isn't every day that the organization against which you have a claim will furnish you with expert aid in developing that claim, but that is what happens when you forget that you hid the family sock in the fire-box of the furnace. Miss Lindsey is manager of the claim section, Division of Loans and Currency, United States Treasury; and on her say-so Uncle Sam has paid out much good money to the victims of fire and flood. There are numerous striking stories of her ability to unravel the secrets of an apparently hopeless pile of ashes.

Miss Roberta L. Lindsey

Dr. William V. Linder

PROHIBITION has put a number of little tasks in the hands of the Federal authorities which they have never had to attack before. There was a time when your Uncle Samuel's only concern with the contents of the flowing bowl arose out of the question whether the tax upon their manufacture had been duly paid. Nowadays he has to worry over the little detail of alcoholic percentage; and this involves chemical analysis. By way of helpful propaganda, while he is analyzing bootleg booze in this connection, the Federal chemist finds it convenient and valuable to answer other questions as to what it contains — particularly whether it contains anything poisonous. Dr. William V. Linder, Government chemist, whose portrait we show on this page, has analyzed over 80,000 specimens of bootleg beverages from every section of the country. Without any particular intent to damage the bootlegger's business, we must record that 95 per cent of these samples contained dangerous poisons of one sort or another. Such gentle little chemicals as carbolic and hydrochloric acids, formaldehyde, pyridine, acetone and iodine have been isolated out of supposed whiskeys. Apparently the bootlegger is supremely confident that new ones are being born every minute, or he would be a trifle less reckless with the lives of the old ones.

THE portrait at the top of the page is that of an indirect contributor to our columns—Sir William Bragg. Our regular readers will recall, from our issue of May, the article by Sir Oliver Lodge, "Putting the Atom to Work." Though this came to us without illustrations, we were able to illustrate it very handsomely with drawings by Mr. Clatworthy, our British staff artist, which in turn were based upon Sir William Bragg's Christmas lecture before the Royal Institution. His selection for this address indicates that he was regarded as able to make clear to the lay mind, in authoritative fashion, the scientific advances of the year—that's what the Christmas lecture is for. He is in fact one of Britain's leading scientists, and one of the world's foremost workers in that fascinating field of atomic physics to which so many of the most industrious physicists are today gravitating. Sir William possesses one distinction which not all of his professional peers can boast—aside from his actual research work, he is the inventor of a very important apparatus for atomic study, the X-ray spectrometer.



Sir William Bragg

USUALLY the onset of the silly season is marked by the recurrence of the sea-serpent yarn. This year, however, the place of the salt-water snake has been usurped by a lovely little stranger. We refer to the wild tale, broadcasted in the name of a fairly well known astronomer whose identity we shall cloak in charity, to the effect that New York is in imminent danger of an earthquake, to be induced by the overloading of vast masses of structural steel and stone upon the underlying rock of Manhattan Island. As no denial has been recorded, we infer that the Professor really said it.

ONE detail which he overlooks is the stability of the Rocky Mountains. If the weight of a solid mass like Pike's peak isn't enough to make the underlying strata slip, an airy fabric like the Woolworth Building or the Pennsylvania Terminal isn't very likely to achieve this result. Another item about which he seems uninformed is the presence, under New York's skyscrapers, of cellars. If the load upon the unit area were of any moment, the structure of the building would be found in some cases to weigh less, and in every case only moderately more, than the rock removed to make room for it. What measure of load has been thus added, over the city as a whole, is largely compensated by the enormous difference between the weight of the subway and of the masses of solid rock whose place it occupies. We should estimate New York's danger from an earthquake of the character pictured as just about equal to its danger of destruction by a comet. If the worthy Professor simply isn't able to stick to the stars, at least he might take the trouble to collect all the pertinent data before he talks on subjects foreign to his field.

JUDGE JULIUS M. MAYER, of the U. S. Circuit Court of Appeals for the Second Circuit, resigned his post in mid-July, to take effect August 1st. Judge Mayer is to engage again in practice, in New York. He was appointed to the Federal District bench by President Taft in 1912, and advanced by President Harding in 1921 to the court from which he now retires. He has distinguished himself in this court by his brilliant handling of large and small receiverships; and at the same time he has been so fortunate as to have had outstanding opportunity to handle several prominent civil and criminal cases in a manner contributing heavily toward the impressing of important legal principles upon the public mind. Our readers will probably know him best through his thorough and forceful handling of the patent litigation that has passed through his hands. In his resignation the Federal bench suffers a loss which it will be difficult to make good.

The late Dr. Albert Abrams, originator of the so-called electronic reactions technique of diagnosis and treatment, and indirectly of the numerous electronic, radio, radiant energy and similar pseudo-scientific diagnostic procedures and "cures"

Our Abrams Verdict

The Electronic Reactions of Abrams and Electronic Medicine in General Found Utterly Worthless

By Austin C. Lescarboura

Secretary to the SCIENTIFIC AMERICAN Abrams Investigation Committee

THE so-called Electronic Reactions of Abrams do not exist —at least objectively. They are merely products of the Abrams practitioner's mind. These so-called reactions are without diagnostic value. And the Abrams oscilloclast, intended to restore the proper electronic conditions in the diseased or ailing body, is barren of real therapeutic value. The entire Abrams electronic technique is not worthy of serious attention in any of its numerous variations. At best, it is all an illusion. At worst, it is a colossal fraud.

These brief statements are based on the findings of the Scientific American Abrams Investigation Committee, which spent more than a year in examining the so-called electronic reactions and their application in diagnostic and therapeutic work. This Committee has studied the technique in detail. This Committee has attended numerous demonstrations of the electronic technique, and its members have submitted themselves to the Abrams diagnosis in order to learn how the matter appears from the patient's point of view. This Committee has procured the genuine Abrams apparatus for the purpose of first-hand study and experimentation. This Committee has made tests with a number of electronic workers, for the purpose of determining the accuracy of the electronic reactions diagnosis in the differentiating of diseased bloods and the identification of similar bloods. This Committee has spent over five months in studying and experimenting with the application of the so-called electronic reactions in the selection of homeopathic remedies. This Committee has kept in touch with electronists from the late Dr. Albert Abrams down to the obscure E. R. A. practitioner, seeking all the while for some tangible proof of a rational basis or any basis for this entire technique. This Committee has studied alleged cures and has maintained a voluminous correspondence with persons who claimed to have benefited by the E. R. A. treatment, as well as with E. R. A. practitioners themselves. All in all, this Committee, unbiased as well as competent to pass upon this problem, has carried on the very kind of investigation which Dr. Albert Abrams asked for time and again, in order that he might establish his claims.

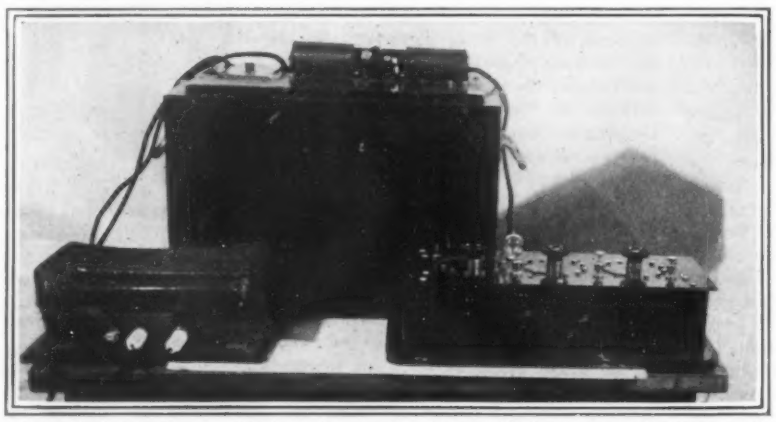
Dr. Abrams and His Electronic Reactions

Several years ago there came from San Francisco a rumor to the effect that a certain Dr. Albert Abrams had discovered a revolutionary principle in medicine. At the very time when the public was making its first acquaintance with the electron theory of matter, there came the announcement that Dr. Abrams had discovered the electrons to be the real basis of life, instead of the cells. These electrons, he claimed, were the foundation of good health or ill health. Even a drop of blood contained millions upon millions of these electrons, and they, in turn, furnished a true picture of the state of health of the individual, if they could only be gathered, sorted out or tuned after the fashion of a radio receiver, and then detected.

Dealing with such minute particles as the electrons are known to be, it was obvious that Dr. Abrams had set a big task for himself. However, in a surprisingly short time this prolific individual had worked out a means of gathering the electronic emanations from a blood specimen. Contrary to scientific expectations, it consisted of a simple container with a pair of electrodes and provided with a cap which carried a third electrode. This device was called the dynamizer. Dr. Abrams worked out a crude resistance box, with three switches and contact points, so as to obtain any desired resistance from 1/25th of an ohm to over 70 ohms. The first switch increased or decreased the resistance by ten ohms for each switch button, the second switch handled single ohms, and the third switch represented 25ths of an ohm. This resistance box was given the attractive name of reflexophone. It was intended for tuning in the different electrons or vibratory rates that might be present in the blood specimen. A second box of the same kind served to introduce additional resistance in the circuit in order to measure the degree or virulency of the diseases in the blood. Still one thing remained to be done, and that was to detect the electrons or vibratory rates tuned in by the reflexophones.

And now we come to the most amazing feature of the electronic technique, namely, the detection of the electronic waves or vibratory rates. Dr. Abrams claimed he had discovered peculiar physiological changes taking place in various portions of the human abdomen, due to the presence of these electronic waves. Thus with the electronic waves reaching the sensitive abdominal nerves, there was a marked change in the percussive note obtained. Again, he discovered that an electrified glass or rubber rod would adhere strongly to certain abdominal areas and not to others, when the electronic waves came through. Still further, he discovered that there was a slight blanching of the skin in a given area, due to the electronic waves, as well as a roughness of the skin that could be detected by the sensitive finger tips trained in this work. These effects in the human abdomen were given the name of the Electronic Reactions of Abrams, or E. R. A. for short.

What did this mean? Simply that Dr. Albert Abrams had worked out a new method of diagnosis, for which he made numerous claims, the least modest of which was that his method could diagnosis with about 75 to 90 per cent accuracy, as against 40 per cent for the conventional method of your family physician. He also claimed he could detect cancer, tuberculosis, syphilis and other pathological conditions in their incipiency, long before orthodox medicine even suspected such things. All told, he frankly admitted that his method must in short order replace all other forms of diagnosis, which had been rendered bankrupt, archaic, obsolete —even criminal, in view of his scientific discovery.



The oscilloclast treatment outfit shown here consists of the oscilloclast in the center background, with its pair of electromagnets and its rocking armature which tick-tocks as it operates; the resistance box or tuning unit, which is said to tune the oscilloclast energy to the proper wave length for the individual patient; and a resistance for reducing the commercial lighting current to the proper voltage for the oscilloclast. One oscilloclast operates as many as six treatment "stations" at a time, each "station" being tuned by means of a resistance box and provided with an impressive but quite unnecessary blinking electric light

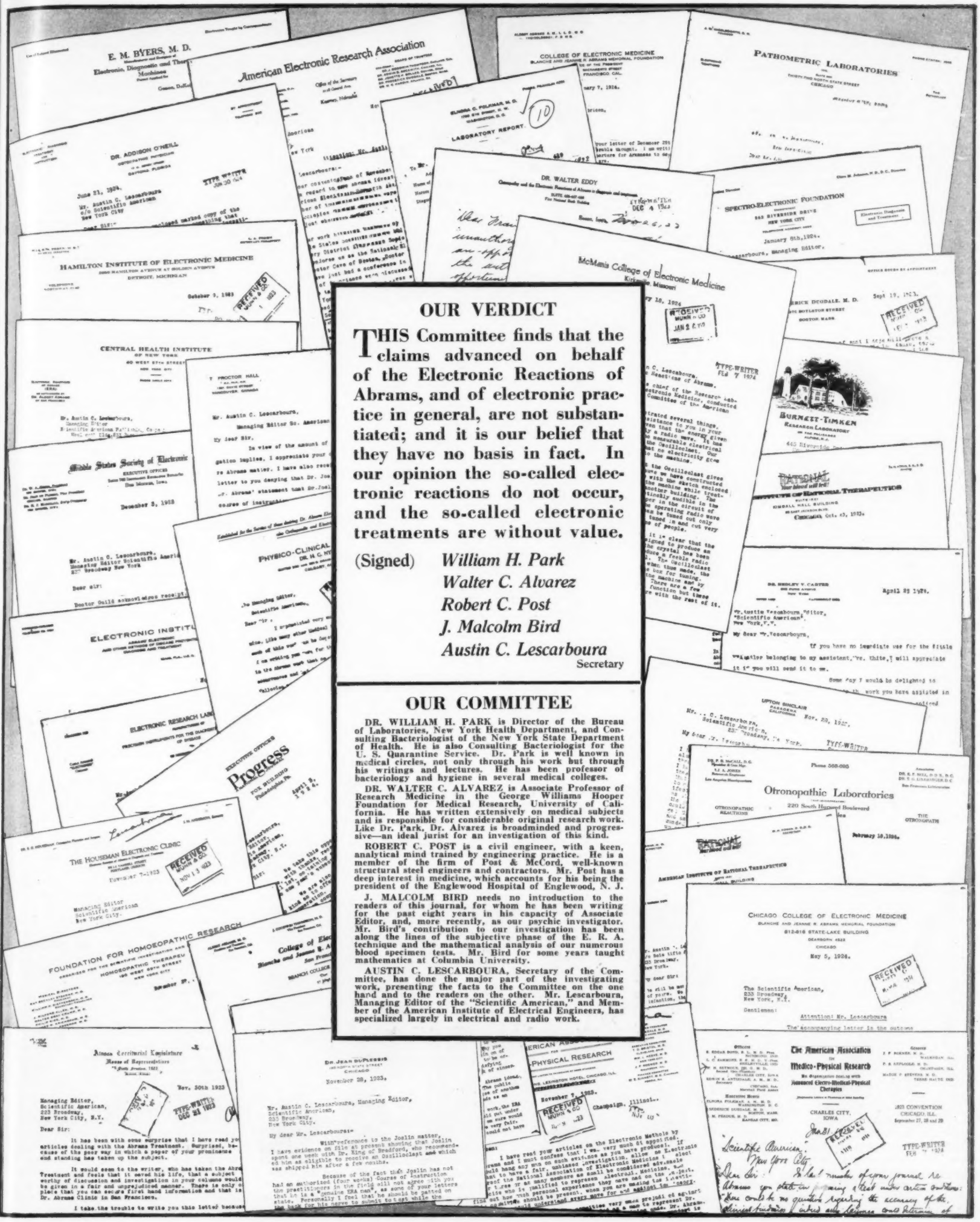
Tick-tocking the patient back to health: the Abrams oscilloclast

Your Life History from a Drop of Blood

Despite the fact that Dr. Abrams had already brought out numerous medical stunts of more or less doubtful value, most of which had already found their way to the medical trash basket, his latest electronic technique rapidly gained ground. Judged by results it was by far his best idea, for it made a universal appeal. Like radio, it had a touch of romance which made it good "copy" for the newspapers, so that publicity was virtually automatic. When Abrams was called upon to determine the paternity of a child in a San Francisco court, merely through the electronic diagnosis of a drop of blood, his technique attracted attention far and wide.

The touch of romance comes in the claim that a drop of your blood tells your life history. Dr. Abrams claimed that his electronic diagnosis enabled him to

An Abrams diagnostician at work, using the percussive method of eliciting the electronic reactions in the reagent. The patient is represented by a specimen of his blood, which is placed in the Abrams apparatus and wired up with the reagent. The nurse is "localizing" an infected tooth



OUR VERDICT

THIS Committee finds that the claims advanced on behalf of the Electronic Reactions of Abrams, and of electronic practice in general, are not substantiated; and it is our belief that they have no basis in fact. In our opinion the so-called electronic reactions do not occur, and the so-called electronic treatments are without value.

(Signed) *William H. Park*
Walter C. Alvarez
Robert C. Post
J. Malcolm Bird
Austin C. Lescarboura
Secretary

OUR COMMITTEE

DR. WILLIAM H. PARK is Director of the Bureau of Laboratories, New York Health Department, and Consulting Bacteriologist of the New York State Department of Health. He is also Consulting Bacteriologist for the U. S. Quarantine Service. Dr. Park is well known in medical circles, not only through his work but through his writings and lectures. He has been professor of bacteriology and hygiene in several medical colleges.

DR. WALTER C. ALVAREZ is Associate Professor of Research Medicine in the George Williams Hooper Foundation for Medical Research, University of California. He has written extensively on medical subjects and is responsible for considerable original research work. Like Dr. Park, Dr. Alvarez is broadminded and progressive—an ideal jurist for an investigation of this kind.

ROBERT C. POST is a civil engineer, with a keen, analytical mind trained by engineering practice. He is a member of the firm of Post & McCord, well-known structural steel engineers and contractors. Mr. Post has a deep interest in medicine, which accounts for his being the president of the Englewood Hospital of Englewood, N. J.

J. MALCOLM BIRD needs no introduction to the readers of this journal, for whom he has been writing for the past eight years in his capacity of Associate Editor, and, more recently, as our psychic investigator. Mr. Bird's contribution to our investigation has been along the lines of the subjective phase of the E. R. A. technique and the mathematical analysis of our numerous blood specimen tests. Mr. Bird for some years taught mathematics at Columbia University.

AUSTIN C. LESCARBOURA, Secretary of the Committee, has done the major part of the investigating work, presenting the facts to the Committee on the one hand and to the readers on the other. Mr. Lescarboura, Managing Editor of the "Scientific American," and Member of the American Institute of Electrical Engineers, has specialized largely in electrical and radio work.

tell how old was the donor of the drop of blood, whether he was white, black, red or yellow; what diseases he was suffering from now; what diseases could be expected in the future, as the result of their being present now in an incipient form; and the expectancy of life. If additional information was desired, Dr. Abrams could tell the religion, the racial traits, and even the location of the individual at any given moment. In fact, during one of his classroom demonstrations he received a photograph of a young man, placed it in the dynamizer, found the young man to be insane as the result of serious syphilitic condition, and then, running an electrode over a map, located the individual at Stockton, Cal. Photographs, strands of hair, handwriting and many other things intimately connected with an individual could be used for electronic diagnosis in place of a drop of blood. The thing was uncanny. It bordered on occultism.

So Dr. Abrams brought about the mail-order idea in medicine. He made it possible for the patient in New York to be examined by the doctor in San Francisco. With the electronic method, the patient has merely to prick his ear or finger tip, carefully following the impressive directions, wipe the blood on a piece of blotting paper or filter paper, place it in an envelope and mail it to an E. R. A. practitioner. The electronic diagnostician takes this blood specimen, places it in the dynamizer, connects the apparatus up with a healthy young man or woman known as the reagent, and then proceeds to analyze your troubles. The reagent responds to the various vibratory rates or electronic waves present in your blood. If you have an infected tooth, the reagent will respond to an infected tooth localization, as it is called. If you have a sore toe, the reagent has a sore toe—but only so long as he is connected with your blood specimen. Hence the reagent is serving as your proxy.

The Mysterious Oscilloclast and Its Elusive Output

Dr. Abrams did not stop with his diagnostic technique. He realized that the world would be but little benefited if dreaded diseases could be detected in their incipiency and their cure entrusted to orthodox treatment. So he set to work developing a new method of attacking disease and again he resorted to his so-called electronic discoveries.

The result is the oscilloclast. Here is an impressive wooden case, provided with heavy side handles and a cover. Opened up, we find a pair of electromagnets and a rocking armature, which ticks away very much after the fashion of a piano student's metronome. The oscilloclast is said to furnish electronic waves of such character as to smash or offset the destructive electronic waves within the patient's body, and thus restore the patient back to normal electronic balance.

There has always been considerable mystery attached to the oscilloclast. Dr. Abrams at first stated that this instrument did not give off electrical energy, and later his followers stated that it did give off electrical energy. In this detail, as well as in so many others, they have not known just what to say. One moment it is minute quantities of electricity, then it is electronic, then radio, and so on. The fact remains that the oscilloclast does not give off any appreciable energy. On the basis of electro-therapy, in which class this instrument would have to be considered if considered at all seriously, it is worthless. If considered according to Dr. Abrams' own claims, then it is obvious that this machine cannot do what is claimed for it. Maintaining a fixed rate of making and breaking the electric circuit which actuates the electromagnets and rocks the rocker armature, it is still supposed to produce high-frequency waves or electronic waves of millions-of-cycles frequency, and over quite a variable range to do the work claimed for it. Yet the only means of varying the wave length is a resistance box, not unlike the reflexophone. One oscilloclast furnishes its mysterious energy to several "stations," each of which is tuned for a given patient.

At any rate, the main object of the oscilloclast is to wipe out those adverse electronic conditions which are found in your blood as the result of the electronic diagnosis. You have been told that your blood discloses congenital or inherited syphilis to the extent of 16 ohms; cancer, 1 11/25 ohms; tuberculosis, 5 ohms; streptococcus, localized in the bone joints, 6 ohms, and so on. All right. Perhaps the electronist is correct—who knows? What about it? How can you be cured? These things don't look so good and you are anxious to get rid of them. Your doctor tells you not to worry, but the electronist must know better. His method is so far ahead of the family doctor with his crude stethoscope! The convincing E. R. A. literature has made its impression on you.

ELECTRONIC TREATMENT Saved Her Life

ELECTRONIC TREATMENT cured what America's most prominent surgeons and doctors of medicine said was a hopeless case. Electronic Treatment saved this child from the grave after the specialists had declared she had only about six months to live.

¶ Here's the story. This little girl was left an orphan by the World War. Her father, a member of the Canadian Army, was killed in the conflict. But before he departed on "the great adventure" he asked his brother to care for his daughter, his only child, should he not return.

¶ Then, when the call was called on "that fatal day" and his lips were mute and his heart was still, "his little girl" he was to see no more became the ward of the uncle who was to adore her as his own, and the more because of the supreme sacrifice the father had paid in behalf of precious life and beloved country.

¶ Now it happens that the uncle was a doctor of medicine, and a man professionally prominent in his community. And being a physician he was able to watch, solicitude with expert watchfulness over the physical well-being of his ward.

¶ There came a day when he discovered that the child was afflicted with cancer that was the result of a bruise, possibly, and was located just below the left knee.

¶ Realizing at once that everything he could do with the various pathological remedies would be of no consequence in this case that his love made tragic he immediately and in desperation sought the help and advice of the most famous surgeons and medical men on this whole continent.

¶ His word everywhere that Hope led him in the search that was all in vain. Finally, in scanning through his copy of the London Graphic, the world-renowned authority in the field of therapeutics, he came across an account of wonderful achievements by Dr. Abrams in the conferring of victory maladies with Electronic Treatment.

¶ Determined to leave no stone unturned in his efforts to save the life of the child that now was so dear to him, and assuring himself that he had everything to gain and nothing to lose, he secured a drop of blood from the lobe of the child's ear, put it on a piece of blotting paper, enclosed the paper in an envelope and sent it to Dr. Abrams with only these words: "Please give me diagnosis of this case by return mail."

¶ No information whatsoever regarding the patient or the disease. Not a thing to guide Dr. Abrams, excepting the drop of blood on a piece of blotting paper.

¶ But here is the answer that came back, and "by return mail": "Diagnosis indicates carcinoma (cancer of the bone), just below left knee. Patient white child about eight years old."

¶ Correct. Absolutely true. Absolutely marvelous. If Dr. Abrams, with the new Abrams invention, the Abrams machine used in Electronic Treatment, could tell so much with only a drop of blood to work with, what might he not accomplish in fighting the cancer that was claimed to be incurable.

¶ At last, Hope had come back. On the very next train the child, with her guardian, started for San Francisco. Arriving here, the forthwith was placed in the care of Dr. Abrams, and within a month she was on the road to recovery. Within a few months she was well again—the cancer was eradicated—cancer was cured—"the impossible" was achieved.

¶ The name of the child and the name of her uncle, and their address, can be furnished upon request. A relative of theirs is one of the better known men right here in San Francisco, and he, as enthusiastically as I, recites the facts I have here related.

¶ Electronic Treatment HAS cured cancer. Electronic Treatment just as remarkably HAS cured consumption. Electronic Treatment HAS cured tumor. Electronic Treatment HAS cured some of the very worst blood disorders and the dreadful diseases traceable to such disorders.

¶ Dr. Abrams is no more, but in left a heritage that is unperishable—his amazing discovery is to be considered one of the most valuable of all contributions to Science in the age.

¶ I continue the work that Dr. Abrams began. If you are ill, and especially if surgeons and doctors of medicine have had to admit that yours is a case beyond their reach, come to me without delay.

¶ By the Abrams Method I treat blood poisoning, high blood pressure, anemia, tuberculosis, cancer, malaria, Bright's disease, prostatic trouble, tumor, female disorders, skin diseases, rheumatism. No charge whatever for consultation—and if I suggest give you the relief you seek I shall tell you so.

¶ In case the patient is too ill to visit my offices arrangements may be made for my callers at the home to give such treatments as may be required.

DR. GEO. D. GILLESPIE

For 29 Years a Practicing Drugless Physician in San Francisco

TWO FLOORS 450-466 GEARY STREET TWO ELEVATORS

TELEPHONES: PROSPECT 5201-5202 :: OFFICE HOURS 9 A. M. TO 10 P. M.

Typical electronic literature which speaks for itself. This is a facsimile reproduction of a half-page advertisement which appeared in the "San Francisco Chronicle" for May 11, 1924. Note the positive claims made for electronic diagnosis and treatment in this advertisement, and compare them with E. R. A. under test conditions

The answer is the oscilloclast. You begin with your treatments. You go to the electronic practitioner once, twice or more often per week. The electrodes are applied to your body as you sit or lie down in one of the little treatment booths, and you receive the soothing electronic surges from the master oscilloclast machine. In your booth there is probably the tuning unit, the little light of which blinks at you in step with the oscilloclast tick-tock. Otherwise, you experience no sensation whatsoever—at least, not if you keep your imagination in check.

At the end of one month, two months, six months or more, the electronist tells you he has good news. Your tuberculosis ohmage has been wiped out, canceled, neutralized, cleared up. Your "strep." is reduced almost to the vanishing point. Your congenital syphilis is practically gone. Perhaps you feel much better than when you first began with the treatment. If so, so much the better; if not, it is no fault of the electronic treatment, because all that treatment is intended for is to wipe out the troublesome ohmages which were found in your blood. Once these are wiped out, the electronist has done his work. Whether you are restored to perfect health or not is a secondary matter, so far as the electronic theory is concerned.

The Old Game of Follow the Leader

Analyzed in the cold light of scientific knowledge, this entire Abrams matter is the height of absurdity. A superficial examination of the apparatus employed alone suffices to condemn the technique. It would never have gained its world-wide application had it not been for the names connected with it. Thus in short order the name of Sir James Barr, past president of the British Medical Association, was tied up with the Abrams technique. Others followed. Upton Sinclair, the brilliant but highly visionary writer, spent some time in the laboratory of Dr. Abrams, and wrote a glowing story of this marvel of marvels under the impressive title, "The House of Wonders." This story was published in *Pearson's Magazine* and, in reprint form, was circulated far and wide. Markey, publisher of *Pearson's*, devoted the major part of his publishing as well as lecturing efforts to furthering the electronic cause, and he has been followed in this work by Lazar, publisher of *Progress*. This publicity has been instru-

(Continued on page 220)

An Abrams instructor, with his collection of electronic apparatus and his blackboard filled with mysterious divisions of the abdomen and cryptic numerals and names, making for a highly impressive but bewildering atmosphere for the doctor as well as the layman

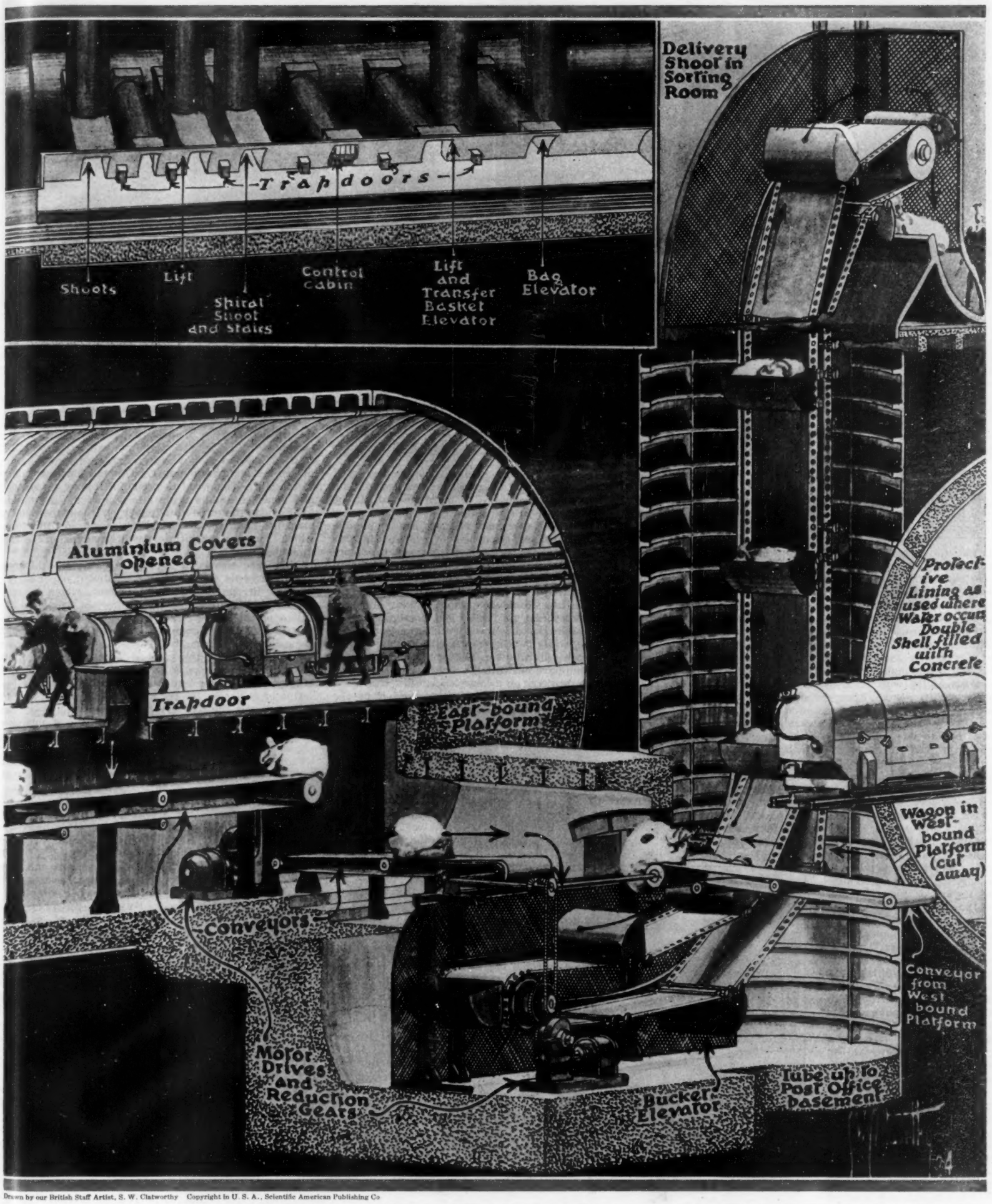
Postal Subways in London

THE drawing on the facing page, prepared by our British staff artist Mr. S. W. Clatworthy, shows London's new Post Office tube railway, now being fitted out, for the carriage of parcels and letter mail, to expedite the service and relieve street congestion.

As yet only the tunnels have been completed, running from Paddington to the Eastern District office. Provision has been made for future branches, the whole proposed system radiating from the chief parcels office at Mount Pleasant. To this end the tunnels have been made larger, with space for additional lines, than will be immediately necessary. At numerous points constructional complications are introduced by the fact that existing passenger-carrying tubes cross the line of the proposed mail tubes; but New York, with its numerous subway crossings, is sufficient proof that these are merely complications, and in no sense obstacles.

The Post Office tube is to be, of course, electrically operated; and except for the loading and unloading of the wagons it will be entirely automatic in its functioning.

The upper panel shows the general arrangement of the tube. The balance of the drawing is given over to a detailed representation of the arrangement at King Edward Building Station, situated beneath the General Post Office. Bags of the usual type go down to the station by chute (it will be observed that the British spelling of this word is not quite so specialized as is ours, and we have felt it best not to tamper with Mr. Clatworthy's original drawing), and come up from it by elevator. The electrical equipment is controlled from a small central cabin at each station, each operator controlling the section of line tributary to his own station. No driver or operator of any sort goes through the tunnel with the wagons or trains of wagons—in this respect the system is quite like the American compressed-air tube for the transport of mail, used in New York and elsewhere.



Drawn by our British Staff Artist, S. W. Clatworthy Copyright in U. S. A., Scientific American Publishing Co

HOW LONDON IS PUTTING ITS MAIL-CARRYING FACILITIES UNDERGROUND, OUT OF THE WAY OF TRAFFIC, IN AUTOMATICALLY OPERATED SUBWAYS **(See facing page)**

Left: Grinding the logs into wood meal, which will become pulp on addition of water. *Right:* Beating and screening machines, in which the wood and water are brought together

The first two stages in the conversion of logs into paper

Pulp and Paper

What They Are, How They Are Made, and Some of Their Uses

By Ismar Ginsberg

PAPER is one of the most important commodities manufactured. It is hard to conceive of our civilization without paper. A world without paper would be quite a different place to live in. When we stop to realize the many uses to which paper is put, the many different ways in which we come in contact with it during our every day life, it is hard to see just how we could do without it. Such a thought leads inevitably to a comparison of the early days of history when paper was non-existent and when the chroniclers, the business man of the day, the common citizen had to use baked clay tablets, or stone plates on which to inscribe their records. The cuneiform tablets of the ancient Assyrians and Babylonians, which may be seen in the museums, were the bills, receipts, letters, records of that era. They come down to us to show how men got along without paper and to what exigencies they were put in their efforts to make lasting records of their transactions, of the historical happenings of the day. Inscriptions on tombs, monuments, etc., represent other ways in which this was done.

There is no one who does not use paper in some form. There is no one who does not realize the importance of this product. But there are really few who have any accurate conception of the many uses to which paper is put besides the commonplace, every-day applications with which every one is familiar, viz., for writing, printing, wrapping, wall covering and so forth.

Furthermore there are but few who have a concrete conception of the enormity of the paper industry, and of the great care and trouble that are entailed in the manufacture of paper. The varieties of paper that are commonly used, everything from a thick manilla wrapping paper for wrapping heavy bundles to the thin, transparent colophane paper that is used to wrap candy boxes and that looks like a very thin celluloid rather than paper, are extremely large. And the conditions under which each grade of paper is made vary, the properties that the paper possesses vary, and the materials that are used in its manufacture vary. This gives a very complex series of manufacturing processes which will be merely touched upon in this article.

Most of the paper that is manufactured is made from wood. However, it is very enlightening to the average layman, who hears a great deal about the waste that the paper makers are creating in the forests of the country, to learn that of all the wood cut every year in the United States only four per cent goes into the paper plant. There are about nine million tons of paper consumed every year in this country, which makes a per capita consumption of more than 150 pounds, or more than twice as much as in any other country in the world.

Of course it must be remembered that only certain kinds of wood are suitable for paper making and that though the percentage of lumber cut employed in the paper process is small, nevertheless the supply of paper-making woods is being continually depleted. The paper companies have taken this condition into consideration and have instituted scientifically conducted reforestration projects on a large scale. Reforestration is a very necessary step in the conservation of the natural resources of the country.

It is very interesting to learn that in spite of the great amount of wood that has been cut down for manufacture into paper since the paper industry started in this country, it has been estimated that this quantity of wood is only as great as that which is destroyed *each year* by the ravages of fire and insects. The fire hazard is being controlled to some extent, but the insect destruction goes on unabated.

There are a number of varieties of wood pulp. The cheapest and most easily made is the pulp that is employed in making newspaper. This is called mechanical wood pulp. The wood is ground. It may be steamed and bleached and is made into a pulp by beating and finally manufactured into paper on the paper-making machine. The rotogravure book paper and newsprint which is used so much these days is made from bleached ground wood.

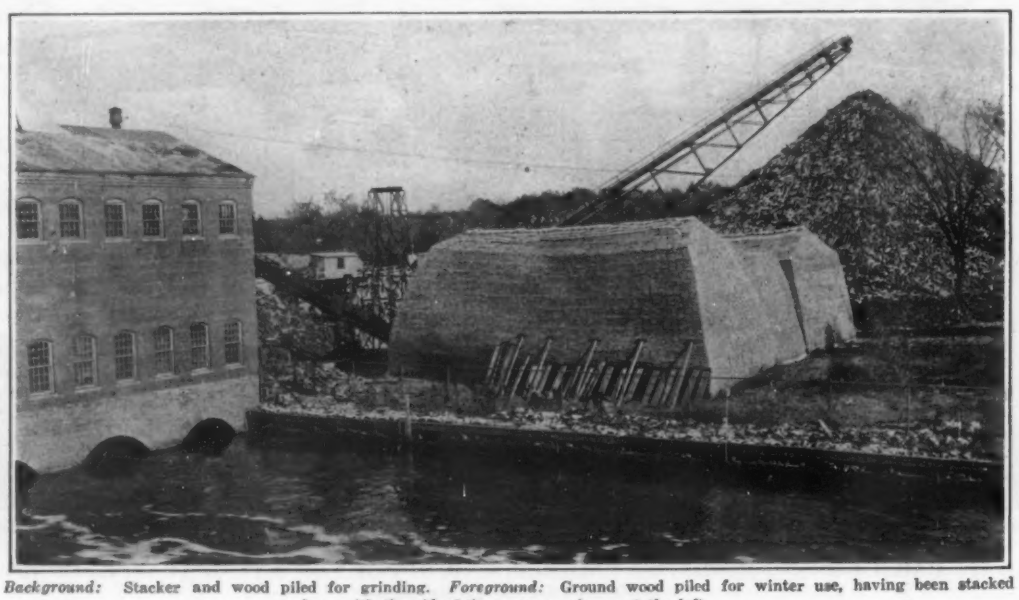
There are also various chemical ways in which the wood is treated whereby better grades of paper are obtained. In one process sulfite liquor, which is made by absorbing sulfur dioxide in lime, is used to make sulfite pulp. This process was invented by an American in 1867, but it remained for Swedish and German engineers to perfect it. There are various derived processes in which this method is used. They all give a fairly high grade of paper that is employed for making wrapping paper and also for newsprint.

One of the most interesting facts regarding the sulfite process is the recovery of the waste liquors, which have been employed for a great variety of purposes. Processes have been developed for making adhesive compositions from it, tanning extracts, building materials, and the like. It has been subjected to fermentation to obtain an impure ethyl alcohol. New uses are being found for it every day.

Another kind of pulp is made by digesting the wood with caustic lye. This process was invented in England in 1854. The pulp obtained from this process is easily bleached and is employed in the manufacture of the finest grades of book papers, magazine and envelope papers, because of the soft texture of the pulp.

Sulfate pulp is made with the aid of a liquor which contains sodium sulfate and sodium sulfide. This is a comparatively new process, having been invented in 1884 and introduced into this country in 1907. It gives a very strong paper and in the unbleached condition and when the pulp is not cooked, it is known as Kraft paper. Kraft paper is very strong and is employed in the manufacture of strong wrapping paper and bags.

There are other processes for making chemical pulp, but so far these have not been developed to a commercial stage. One of the most promising of the processes is the chlorine process wherein the wood is subjected to the action of chlorine gas.



Background: Stacker and wood piled for grinding. *Foreground:* Ground wood piled for winter use, having been stacked here with the aid of the conveyor shown at the left

The stock pile of a typical paper mill

Not all paper is made from wood. The finer grades of writing and printing paper are manufactured from cotton and linen rags. Very little paper is made that contains 100 per cent rag stock. The usual practice is to mix this high-grade pulp with wood pulp. Paper made in this way is very strong and can be bleached to perfect whiteness. It makes a very fine writing paper and is also employed in printing expensive books.

There are also other materials of inferior properties to wood that are gradually coming into use throughout the world for the manufacture of paper. This is due to the fact that the woods which are particularly well suited for paper making, such as poplar, fir, birch, spruce, pine, hemlock are becoming scarcer and scarcer each year, although reforestration, carried out on a broad, scientific basis, will provide supplies of these woods in the future.

Hence the tendency has been to experiment with all kinds of vegetable matter as possible sources of pulp. It must be remembered that theoretically any cellulose matter, such as common straw, the stalks of the corn plant, reeds, grasses, in fact anything that grows and contains cellulose, is potential paper stock. The reasons why these cheap materials are not used is because they do not contain enough cellulose to make it worth while going to the considerable expense that is entailed in removing the large amounts of impurities that they contain and which must be eliminated before paper can be made.

Nevertheless, paper has been made from straw, esparto grass, which is found in several European countries, bamboo fiber, sugar cane bagasse—the remains after the sugar has been extracted from the cane—giant grass reeds that grow in certain localities in Florida, and other similar products. The papers that are made from such materials cannot be bleached without the consumption of considerable bleach and are generally coarse and of rather poor quality. However, the products are paper and take the place of more expensive papers made from wood. They are satisfactory for certain purposes, such as wrapping bundles, making boxes, cartons, and similar products.

Before considering the various uses to which pulp and paper can be used besides those that are commonly known, it will be well to review in few words the paper-making process. When paper is made from wood, the wood is first ground up and chipped; when it is made from other materials, the first step is always to comminute the stock. Then the particles are treated with chemicals in digesters. After the impurities have been rendered soluble and removed, the digested stock is fed into beaters, which pulp the stock by subjecting it to a combined compression and shearing action between steel blades, fastened on a roller and imbedded in a bed-plate in the bottom of the beater. The water in which the stock is beaten is caused to combine with the fiber, which becomes hydrated.

During the course of beating various substances, which are employed in changing the properties of the fiber so that various kinds of paper can be made from one and the same stock, are added. Thus in making paper used for writing and printing and required to hold ink, rosin solution and sulfate of alumina are added. Coloring matters of various kinds, fillers, such as clay, chalk, satin white, barytes, etc., are also added. In making white paper the pulp is bleached with ordinary bleaching powder or liquid chlorine in a special beater.

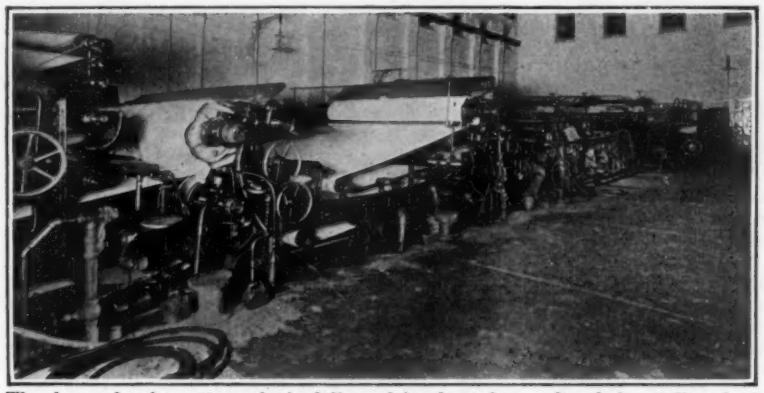
Then the pulp is ready to be made into paper, which is carried out on a cylinder or shaking wire—Foudrinier—machine. The paper is dried, calendered to give it different finishes and then is ready for use.

Paper pulp is used primarily in the making of paper, but there are many other little known, interesting applications to which this material is put. Wood pulp can be mixed with a variety of substances, the latest being rubber latex imported into the country in the liquid condition from the Ceylon plantations to make plastic compositions which dry out or are converted by chemical change into hard, strong, elastic products which may and can be used in the place of natural wood. Thus it is used in making toilet seats, in the manufacture of chairs and other articles of furniture. Pulp can be made into a form of leather that is used in upholstery and for covering walls. Wall-boards and building board have been made from pulp, and in these cases it has been necessary to mix waterproofing agents with the pulp in order to render the product resistant to the weather.

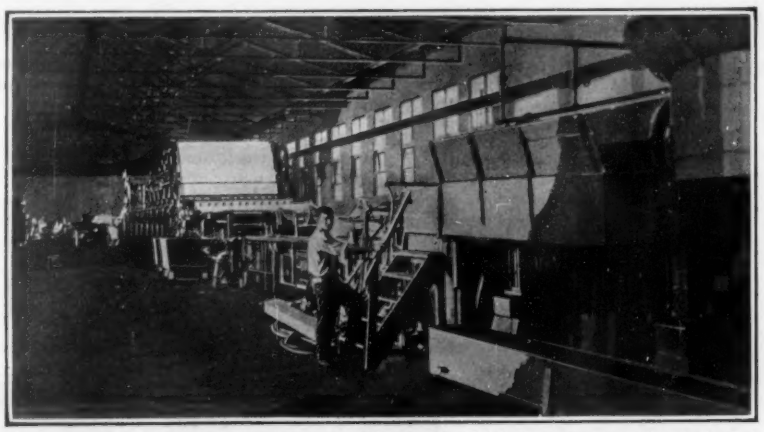
In Austria experiments have been made to make building stone from pulp and some success has been obtained along these lines. Composition flooring is also made from wood pulp. It makes a very fine flooring which can be colored in the mass in permanent shades.

Wood pulp is also used in the manufacture of toys and novelties of various sorts. It is the starting point for the manufacture of celluloid. Celluloid is nitrated cellulose and has commonly been manufactured from cotton linters. The nitrated product is mixed with camphor which gives this rather remarkable substance. Wood pulp can be used as a raw material in this process and a good grade of celluloid can be obtained.

Wood pulp can also be used as a starting point in the manufacture of nitrocellulose for conversion into smokeless powder. It may also be employed in making artificial silk. The pulp is dissolved in caustic soda solution which is also said to contain a certain proportion of carbon disulfide as well as other ingredients. The thick solution is then squirted through tiny holes in a brass plate and the issuing thread of material is caused to coagulate into a stable substance by coming in contact with alcohol or other similar liquid. These extremely thin filaments are then combined by twisting into an artificial silk thread.



The dry end, where the pulp is delivered in sheet form after being relieved of its excess moisture



The wet end of the paper-making machine, into which the macerated pulp is fed

Boxes, utensils of all sorts, different articles of every day use can and have been made from paper pulp. For this purpose the pulp must be waterproofed to be able to withstand the action of liquids with which it comes in contact. Waterproofing can be accomplished in a variety of ways, as, for example, by impregnating the pulp with aluminum resinate or other substances.

There are even more uses for paper that are not commonly known than for woodpulp. One interesting use is in gardening. While this is not altogether new, especially to those gardeners and other individuals that follow up new developments closely, the advantages that are possible from its use are not generally known. Paper is a good heat insulator, and while it is naturally opaque, it can be made transparent by oiling. In this condition it has been employed in France and other countries in the place of glass in hot house frames. The oiled paper stands up against the severest weather and gives as good results as the more expensive glass. The soft diffused light which streams through the oiled paper is particularly advantageous to the growth of young seedlings. When glass frames are used, direct sunlight must be shaded off as it has been found to be injurious. Old newspapers have also been used to protect plants against the cold during the frosty nights of early spring.

It is not new that paper is employed in making clothing, but it may be news to most readers that an attempt has been made in this country to manufacture raincoats from paper. The paper is waterproofed and the raincoat made from it is supposed to sell for about 25 or 50 cents. The project sounds interesting but hardly practical; still it is possible that a paper raincoat may serve for one usage anyway. Carried in the pocket, it may enable the wearer to laugh at the rain when caught in a sudden shower.

Paper is used in the manufacture of good as well as poor quality shoes. In cheap shoes it is not surprising to find the soles made from paper. In good shoes the box toes, the counters, heel boards, and other parts are made from paper.

Paper has been employed in the manufacture of various technical products, such as pulleys, car wheels, packings for gas engines and hydraulic machinery, calender rolls, barrels, etc. It is employed in making spoons, dishes, trunks, suit-cases, cups, saucers, table covers, bags of all descriptions, artificial flowers, water pails, clothes lines, imitation tapestry, etc., etc.

One rather interesting and strange use of paper is in the manufacture of piles. Piles are used in the construction of docks and wharves and it appears hardly possible that paper be employed for such a purpose, as it is commonly known to be rather weak in strength and extremely absorbent. But if the paper is compressed under great pressure, as is used, for example, in making car wheels from this substance, a product is obtained which possesses a surprising hardness and resistance to wear and tear. Furthermore its porosity is reduced by such treatment, an effect which can be easily enhanced by incorporating waterproof agents with the paper or else painting the outside surface with a waterproof paint. The reason for using paper for this purpose is that marine boring worms, which do so much damage to wooden piles, have no effect on paper piles.

Piping has been made from paper and products have been developed which are impervious to heat and to moisture. The ends of the pipe can be cut for threading on to pipe connections just the same as metal.

Spools on which thread is wound are made from paper. The impression on candies, carrying the trademarks of the makers, is made with the aid of paper molds. Dress forms can be made of paper by pasting gummed paper over an undergarment and then removing, coating with shellac.

One interesting variety of paper is metallic paper. This is made by coating paper with a metallic film which is applied to the paper, which has first been covered with an adhesive coating. The metallic film is then pressed up against the adhesive and fixed firmly to the paper web by cold pressing. Paper as an insulator is widely employed in the electrical industry.

Many special varieties of paper are manufactured, each suited for particular purposes. Thus paper is made with iridescent coating by spreading a solution of cellulose acetate on the surface and allowing the solvent to evaporate. Such paper is used for decorative effects. Paper with a leather-like finish is made by spraying or painting with special varnish preparations. Such paper can be used for binding books, covering walls, upholstering furniture and other purposes. Inlaid papers are manufactured on special machines and used for similar purposes.

While real celluloid can be made from pulp, a celluloid substitute can also be manufactured from paper. For this purpose a highly calendered paper is employed, which is treated with glycerine and then embossed. Paper is also made with a coating of textile materials. Paper with a thick varnish coating is said to be well suited for out-of-door bill posting, as the rain and weather have no effect on it. Such paper can also be used in making floor coverings. Velvet paper, transparent paper (for making self-addressed envelopes, and the like), washable writing paper, stained and marbled paper, and many other kinds are also manufactured.

The uses of paper are really too numerous to describe. It enters into our daily lives in so many different ways that it is no surprise to learn that the total quantity of paper made in the world in a year's time is as much as fourteen million tons.

Oscillator unit of the 100-meter WGY transmitter, showing the water-cooled tubes, one of which is used as the oscillator and the other as the modulator

Re-Broadcasting the Broadcast Program

Short-Wave Radio Telephone Transmission and What It Means by Way of Better Programs

By W. J. Purcell

Radio Engineer, General Electric Company

ONE of the most interesting contributions to radio during the present year has been the development and successful operation of the short-wave transmitter. By its use distant places, heretofore only occasionally reached on long wave lengths, have become readily accessible with a fair degree of reliability. Signals are transmitted so clearly and with such volume that it is possible to pick them up 3000 miles away and successfully rebroadcast them.

For several months past, WGY, the Schenectady station of the General Electric Company, has been experimenting with a short-wave transmitter; and on April 5 these experiments, carried on in cooperation with the British Broadcasting Company in England, reached a climax when every station in England relayed or rebroadcast the WGY short-wave signals. A radiogram received from London during the progress of the concert, enthusiastically proclaimed it "all as clear as if played in London." The concert broadcast was held in the Wanamaker auditorium in New York and consisted of organ, tenor solos, trumpets and speech. The program was conveyed by line circuits to WJZ in New York, from which point, after amplification, it was conveyed over wire to the control room of WGY in Schenectady. There it was twice broadcast, that is, on a short wave length of 107 meters and on 380 meters from the regular transmitting equipment. The short wave length signals, inaudible on most receiving sets, crossed the Atlantic and were picked up on a sensitive receiver by 2 LO in London, and were then fed by wire to all the stations making up the British Broadcasting Company group. Crystal set owners in London and Manchester and other places near English transmitting stations, reported excellent reception of the music played in New York.

While the design of a short-wave transmitter is similar to that of any broadcasting set, the enormously high frequency involved—2803 kilocycles (2,803,000 cycles)—requires the use of some unusual and novel apparatus. As shown in the accompanying picture, the antenna used is of the fan type, but it differs in some respects from the conventional antenna. In order to decrease resistance losses, its conductors are made of three-eighth inch hemp, over which is braided many fine strands of bare copper wire. The two wooden poles supporting the antenna are much larger than necessary to support a structure of this size, but they are essential to prevent the antenna from swinging. Swinging antenna results in frequency change, which in turn means wave length change, thus interfering with proper reception.

The building that shelters the transmitter proper is located slightly to one side, allowing the counterpoise—a second elevated wire network that takes the place of the usual ground connection—to come directly underneath the center of the antenna, greatly increasing the radiating efficiency of the system. The antenna is 80 feet high and 60 feet in width at the top portion of the fan. It has a fundamental wave length of 160 meters.

In order to secure maximum radiation the transmitter is located on level ground, a mile from the nearest building. The building is located near the bend of the Mohawk river, and conductivity of the soil in the vicinity is therefore comparatively great.

The oscillating system is of the conventional coupled-type in which the frequency is controlled by a tuned circuit rather than the antenna circuit, greatly eliminating the possibility of frequency change due to the swinging of the antenna in the wind. The primary coil consists of one and one-half turns of copper ribbon two inches wide, and this is tuned by an air condenser made of aluminum plates three feet square. In solving the problem of a spacer for these plates that would not break down, the use of very thin hard rubber strips was decided upon. The power tubes are of the water-cooled type, connected through a pump to a large radiator which insures an uninterrupted water supply. The entire unit is suspended by springs.

Owing to the extremely low wave length used, many freak effects are noticed. In building a transmitter the usual practice is to connect all metallic objects, such as iron frame work, transformer cases and motor generator frames, with copper ribbon. This procedure cannot be followed in short-wave transmission because, while the inductance of a conductor only a few feet long is very small, it is great enough to allow a considerable voltage to be built up across it at this frequency.

Because of the intense field about the transmitter, it is necessary to observe great caution while the set is in operation. Two men standing on insulated stools, each holding a metal rod in his hand, can draw an arc six inches long between the rods. No shock is felt because current of this nature travels through the skin rather than through the body. However, if the bare hands were used instead of the metal rods a severe burn would be the result. Arcs will jump from the stove to the shovel when adding coal, and care is necessary to prevent the body from coming in contact with any metallic objects. It is possible to light an ordinary 60-watt electric lamp to full brilliancy by holding the glass bulb in the hand. Metal pencils, watches and like articles cannot be carried on the person because of the small sparks which jump to them. Shoes with metal nails cannot be worn because of the sting experienced when the wearer steps on the nails in the wooden floor.

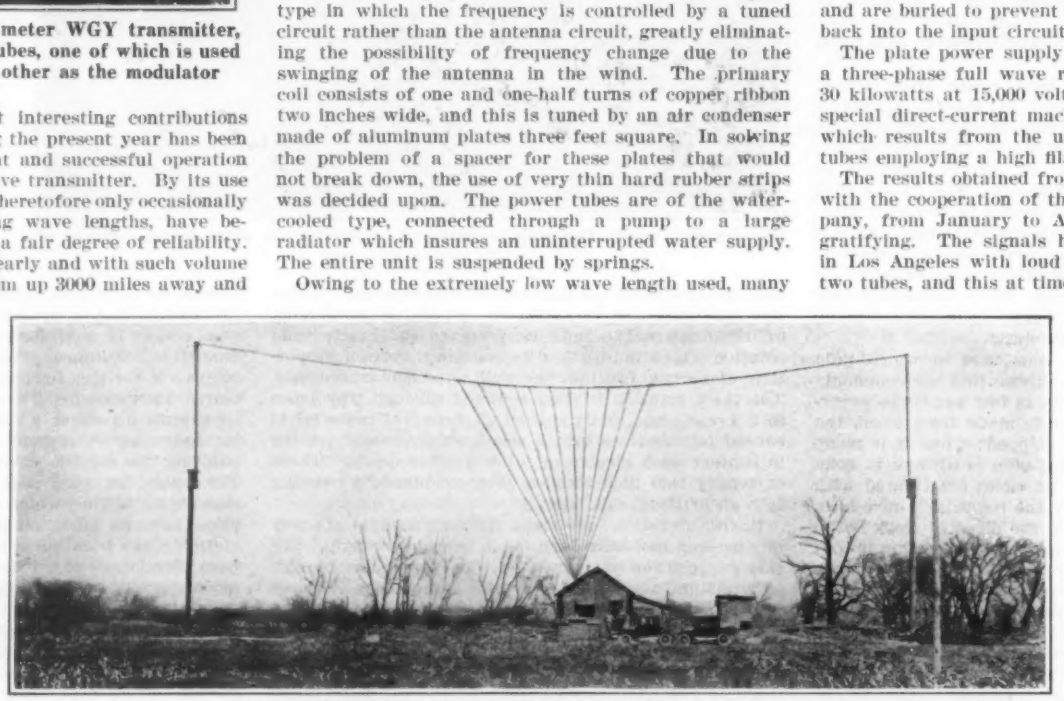
The modulator tube is water-cooled and connected to the same cooling system as the oscillator. The speech power amplifier is a 250-watt tube, and, because of the intense field from the oscillator and its associated apparatus, it is shielded by a copper box to prevent regeneration and the resulting loss in quality. All wires connected to the amplifier are shielded, while the lines to the studio and control room are covered with lead and are buried to prevent the radio signal from getting back into the input circuit.

The plate power supply to the water-cooled tubes is a three-phase full wave rectifier capable of supplying 30 kilowatts at 15,000 volts. Filaments are lighted by special direct-current machines to eliminate the ripple which results from the use of alternating current on tubes employing a high filament current.

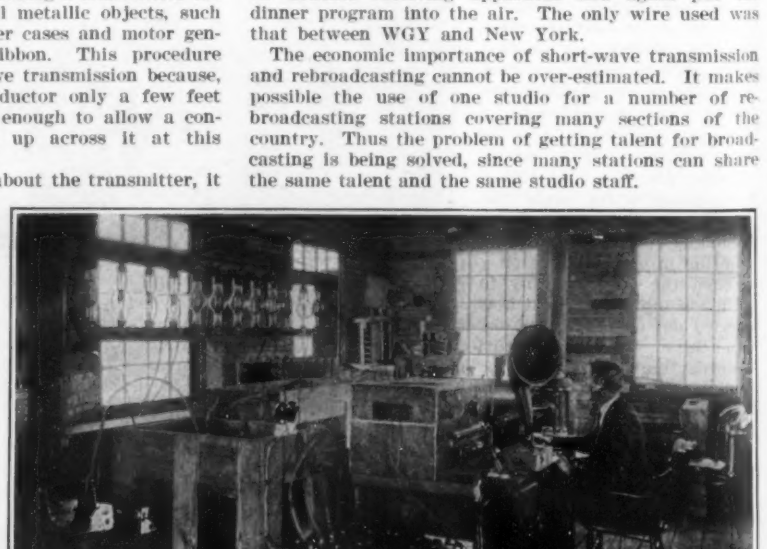
The results obtained from a series of tests conducted with the cooperation of the British Broadcasting Company, from January to April 5, have been extremely gratifying. The signals have been heard consistently in Los Angeles with loud speaker strength using only two tubes, and this at times when daylight covered the western half of the country. Tests have shown that the signals are remarkably free from fading which is experienced on the longer waves.

At the annual dinner of the Massachusetts Institute of Technology alumni in New York, WGY connected to New York by a special circuit, broadcast the music and speeches on 380 meters wave length and on 107 meters. The signals on 107 meters were so strong and clear that Pittsburgh picked them up and sent them to Hastings, Neb., which again rebroadcast. Finally KGO, the General Electric Company at Oakland, caught the three-times-relayed signals on delicate receiving apparatus and again put the dinner program into the air. The only wire used was that between WGY and New York.

The economic importance of short-wave transmission and rebroadcasting cannot be over-estimated. It makes possible the use of one studio for a number of rebroadcasting stations covering many sections of the country. Thus the problem of getting talent for broadcasting is being solved, since many stations can share the same talent and the same studio staff.



Fan type antenna used by the WGY 100-meter experimental station at Schenectady, N. Y. The conductors are made of ⅜-inch hemp over which is braided many fine strands of bare copper wire to decrease resistance losses. The antenna is 80 feet high and 60 feet wide



Rectifier tube assembly of twelve tubes in the short-wave experimental station of WGY. The transmitter appears in the center background

Acoustics and Plaster

IT is coming to be more and more generally recognized that the control of *sound* in buildings is as important to the health and comfort of the occupants, as is any other feature for which the designer must provide. The nervous tension, and irritation resulting from prolonged effort to hear under poor hearing conditions, the wear and tear on nerves, produced by the interminable racket of a modern office, are just as destructive to human efficiency as is improper lighting, or poor ventilation.

It is not sufficiently well known that the problem of the control of sound in buildings has been solved. The scientific work necessary to this solution, as well as the practical application of the method, is largely the work of one man, the late Professor Wallace C. Sabine of Harvard University. Twenty-five years of the most painstaking and careful investigation resulted in a complete theory of the behavior of sound in rooms, the establishment of a working criterion of excellence of acoustic conditions, and the development of a practical means of securing desired results.

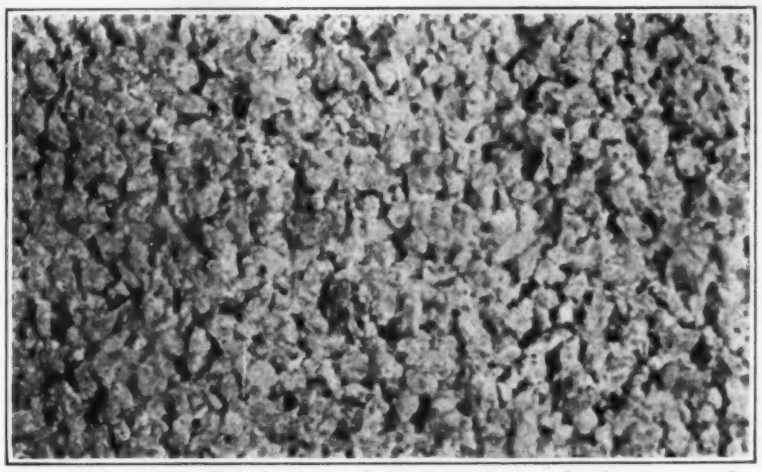
Perhaps the most outstanding generalization from Professor Sabine's work is the demonstration that the *absorption* of sound is of prime importance in the control of acoustic conditions. Most of the earlier work on the problem had been in the direction of control of sound by reflection from properly shaped contours, amplification by artfully designed sounding boards, and direction and control by properly curved walls and ceilings. Quite in contrast with commonly accepted notions, Professor Sabine found that difficulty in hearing in rooms generally resulted from *too much* rather than *too little* sound.

Scientific measurements in recent years have demonstrated that the human ear is an extremely sensitive instrument. The physical intensity of the sound of ordinary conversation is of the order of a million times the least intensity which the ear can detect. For normal ears, difficulty in hearing and understanding speech arises not so much from a lack of intensity as from a lack of distinctness—that is, of complete separation of the successive elements of speech or music. The problem of securing good hearing conditions in a room is a mere matter of insuring that each separate element of speech or music shall not be prolonged into the succeeding elements.

Now this prolongation of sound in a room, technically known as *reverberation*, is responsible for a very large proportion of the cases of faulty acoustics. The absorbing power of a surface may be defined as the product of its area, multiplied by the fraction of the sound energy that is absorbed each time sound strikes that surface. The absorbing power of a room is then the sum of such products for all the surfaces, walls, ceiling, floor, furnishings, and occupants upon which sound strikes. For sound sources of ordinary power, such as a loud speaking or singing voice, a violin, or an organ pipe, the time T of reverberation depends solely upon the room's volume and its total absorbing power, and can be computed by formula. Experiment in a large number of rooms has shown that for satisfactory conditions, the value of T should be between one and two seconds. If it is much greater than this the "ring," or reverberation in the room results in confusion. If it is much less, a noticeable effect of dullness again results in confusion.

Clearly, then, reverberation in a room may be controlled by securing the proper ratio of absorbing power to volume. The modern tendency toward the use of very hard interior-finish materials, which are very highly reflecting and only slightly absorbent, is in the direction of a decrease of absorbing power with a consequent increase in reverberation in rooms. Recognizing the desirability of a material that should be highly sound-absorbent and at the same time entirely structural, Professor Sabine invented an acoustic tile that is many times as absorbent as the usual masonry surfaces, and is an admirable solution of the problem of reconciling good acoustics with good construction.

So much for the structural elements; but what of the visible surface? The ordinary plasters, generally speaking, absorb only two or three per cent of the sound that strikes them. Research looking toward the development of a *plaster*, to be applied in the usual manner, which should be much more highly absorbent than this, was begun more than four years ago at the Riverbank Laboratories, a general description of which was given in the SCIENTIFIC AMERICAN for September, 1923. The physical properties necessary in a material, that, when plastic, can be readily handled with a trowel, and, when hardened, will be highly absorbent, are mutually antagonistic. Either property alone can be readily secured but a combination of the two in the same material was found to be difficult. First, a thoroughgoing study of the chemistry of plaster bonds,



Close-up view of the Riverbank sound-absorbent plaster, showing its granular structure

their relative tenacities, and the physical, and chemical changes involved in their "setting" was made; and it appeared that a magnesium oxychloride bond was best suited to the purpose in hand. The choice of a suitable aggregate called for a long series of experiments; exploded slag from Bessemer converters finally proved to have the desired qualities with the required ingredients. It was next necessary to work out the proper proportions to give a mortar that can be easily handled, that will have the desired setting properties, and that will yield a plaster with the required hardness, texture and color, and at the same time with the acoustic properties desired.

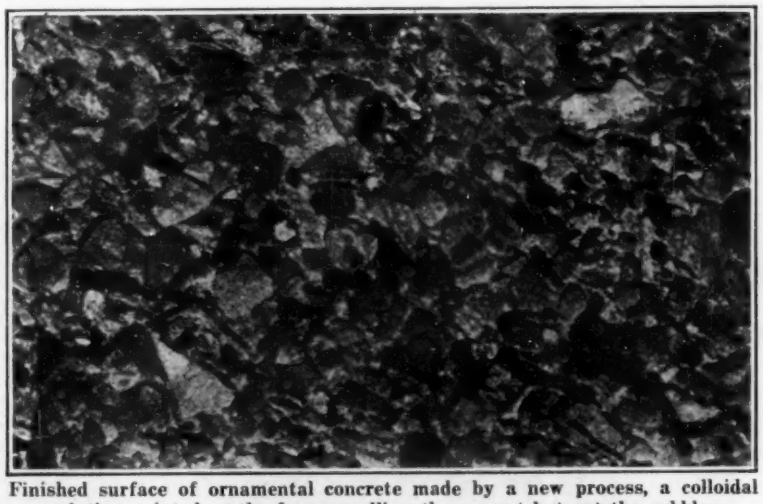
Having arrived at what might be called a satisfactory laboratory solution of the problem, the question of a practical demonstration of the acoustic properties of the new material was next in order. For this purpose two rooms of the same size and shape in the new laboratory were available. One of these was finished in the ordinary manner using hard plaster with a smooth finish. In the other, two coats of the sound-absorbent material were applied to the usual "*scratch*" coat of ordinary plaster. Otherwise the rooms are identical. No instrument save the ear is required to detect the difference.

Each of a set of calibrated organ pipes was sounded successively in the two rooms. The time during which the sound remained audible in each case was noted by means of a chronometer especially constructed for the purpose, and is reported in the *American Architect* by Professor Arthur L. Foley of the University of Indiana. With a pipe of frequency 128 (vibrations per second), the sound lasted 8.32 seconds in the ordinary room and 4.03 seconds in the other. With a Middle-C pipe of 256 frequency, the respective times were 7.00 and 2.70 seconds. For frequency 512 the times were 6.5 and 1.0 seconds; for frequency 1024, 5.5 and 0.3 seconds. With frequencies 2048 and 4196, the ordinary room gave reverberations lasting 4.4 and 2.2 seconds, respectively, while in the other the duration was too short for measurement. Computations made from these and similar tests show that at each reflection from 10 to 30 per cent of the sound energy is absorbed in the special plaster as compared with from two to three per cent by ordinary plaster.

In addition to the reduction of excessive reverberation with the resultant confusion of sounds in audience rooms, an absorbent surface for walls and ceilings effects a very marked decrease of intensity of sound from a constant source operating within a room. Thus in the empty room referred to above, and finished in the ordinary manner, the click of a typewriter lasts some five or six seconds. There is in the room at any one instant of time the sound that is produced at that time plus the residuum from sounds made during the five or six preceding seconds. The total amount of sound in the room when a typewriter is being operated continuously is about five times as great as the sound given out at each click of the instrument, and it is distributed almost uniformly throughout the room. As a result a large office unit is a perfect bedlam of noise under which human nerves are worn and human efficiency falls off rapidly. The usefulness of a structural material that will eliminate most of this is obvious.

The head of one of the largest hospitals in Chicago is responsible for the statement that "noise is one of the greatest curses of the modern hospital." The hospital corridor with its smooth hard walls, and absence of any absorbent material is a 100 per cent transmitter of noise from room to room. Here again the value of a structural material that will transform these walls from sound mirrors to sound absorbers is obvious.

One might cite a large number of cases in which a cheap, permanent, and readily applied means of sound absorption will be of distinct advantage. The mail brings almost daily problems, whose solution calls for such a material, and it has been mainly through the number and insistence of these demands that the investigation has been carried to a point at which a thoroughly practicable solution has been reached.



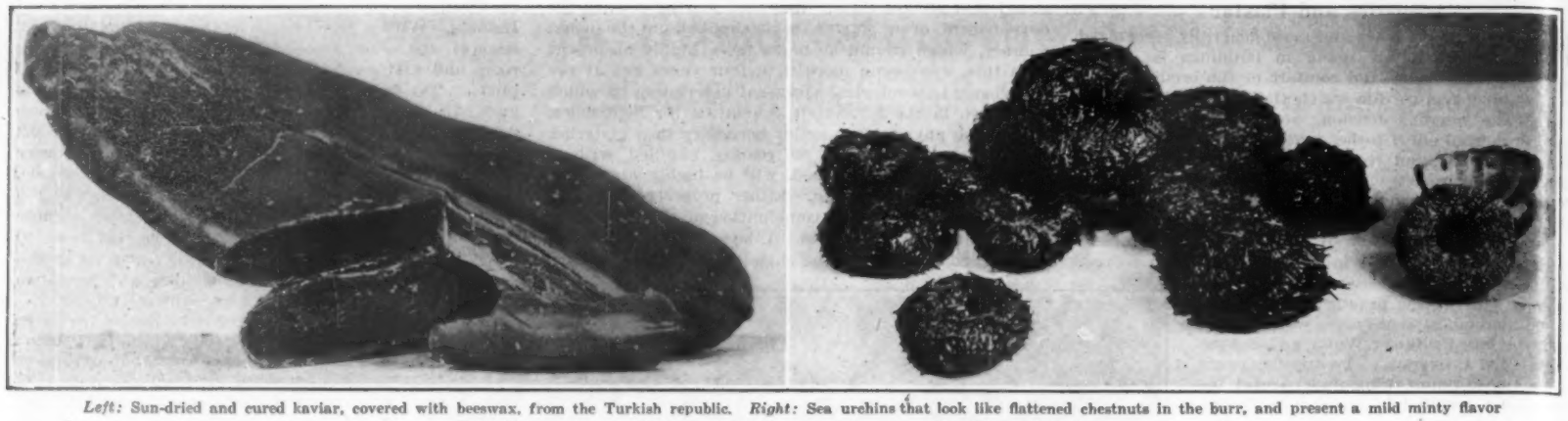
Finished surface of ornamental concrete made by a new process, a colloidal solution painted on the form repelling the cement but not the pebbles

Cast Up by Salt Lake

WHEN the water of Salt Lake, Utah, reaches a temperature below 30 degrees Fahrenheit, it manufactures sodium sulfate and accomodatingly casts it up on the beach. The fact that the deposit of sodium sulfate can be gathered before it goes back into solution has led to the construction of a plant for harvesting and refining the material into a commercial product. The average period of production will be two months each year. During a season of mild winter there may be none produced and during years of cold winter the sodium sulfate may be precipitated for three months, judging by weather records of twenty years.

A New Principle in Concrete Work

CERTAIN kinds of decorative concrete work require a large outlay of money for creating the neat, pebbled surface that seems so desirable in places where plain concrete is not considered attractive. A New York inventor, Mr. Nathan C. Johnson, has found a way to do this work so easily that it seems like magic. He has developed a solution (which he states is a colloid of some sort) and which resembles common molasses. Its most valuable characteristic is that it repels cement. When the parts of the wooden forms opposite the faces of the concrete on which it is desired to have the pebbled finish are painted with this solution, and the concrete is poured in as usual, the cement in it is held away from the forms about one-eighth of an inch until setting has taken place, while the pebbles are not affected. It is claimed that the cost of this work is about one-third of the cost of work of a similar nature as done by common labor.



Left: Sun-dried and cured kaviar, covered with beeswax, from the Turkish republic. *Right:* Sea urchins that look like flattened chestnuts in the burr, and present a mild minty flavor

Two things to eat that are bound to puzzle one unfamiliar with them

What the Other Half Eats

Some Interesting Exhibits from the Foreign Food Stores of a Big American City

By L. Lodian

ONCE upon a time, if one wanted to eat, one had but two alternatives—one might eat in one's own home, or one might seek a regular restaurant. Including the boarding house in the former category and the hotel in the latter, there was nothing between the two—even the saloon that served "eats" masqueraded as a restaurant. But today it is very different. The so-called bakery lunch or bakery restaurant has had an enormous development in America within two decades. In all of our cities, the bakers serving every nationality—and baking is peculiarly an institution of nationalities—have gone in for this form of business, perhaps merely in the search for an extra dollar of profit, perhaps because they had all the tools of cookery and all the finished products of the bake-room which are contracted for by the restaurant trade, and so could not resist the suggestion to try their own luck at dealing with the ultimate consumer. The result is that one interested in the curious food products described in this journal, from time to time, by the writer, may experiment with these comestibles not merely in the foreign-colony grocery stores, but equally among the bakery restaurants of foreign proprietorship, where they may be assured of foreign cooking as well as foreign food.

The rose-flower marmalades of oriental countries have been made since earliest antiquity; and today they are regularly imported and sold among near-east and far-east colonies in the leading United States cities. The Chinese laundryman in any town—and what place of size or pretension to size is without one?—can tell of the nearest grocery handling his strange wares; in fact, he himself usually sells package teas and similar products "on the side." The container illustrated holds five pounds of the luscious and delectable rose-marmalade—a compost of fragrant rose leaves and wild or virgin honey. The granular form of the solidified mass of honey is distinctly noticeable in the final product. Sometimes cherry sugar, made directly from the fruit, is used; sometimes date sugar, or palm sugar.

This rose-marmalade holds its fragrance and flavor to the last ounce, provided it is used out of the original container until used up, being kept the while in a cool place. It must be used cold at the table, served from the can; heating dissipates the rose bouquet, and leaves merely an agreeably tasting sweet confection.

The marmalade is rather a dingy-looking reddish mass, sometimes nearly black in parts, due to the dark color of the wild honey used. Its appearance reminds one somewhat of the choice black-currant preserve which the tourist meets in British inns and homes. Newly opened, a container sends a whiff of rose fragrance through the room; it is, of course, not the odor of the fresh rose, but as from a bunch of roses a day or two old. This persistent odor seems to intensify the sweetness of the marmalade, rendering it too cloyingly sweet for some palates, so it must be used sparingly.

From the historic Tigris-Euphrates valleys, and various vilayets of the Turkish republic, comes a white-rose marmalade in 28-pound containers. It is of better appearance than the transpacific article, but its size renders it less convenient. The fragrant white roses for which the Damascus region is famed are alone used; the sweetener is either raisin sugar or currant sugar (this last much esteemed in the Greek zone), or the grass-sugar *imfi*, or the manit-sugar of Asia Minor.

There might be an idea for home consumption in these rose marmalades. Why should they not be made in American preserve factories? Their continuous sale for the past half-century or more among the exotic colonies of the United States is proof that a demand exists. Florists having a surplus of goods on their hands might thus find a market in place of a loss.

A capital marmalade from the jujube fruit is made in France and sold among Gallic importing groceries on Manhattan's isle. A similar article from Russia is made from lemons, and is sold as cheese—you cut it with a knife, using it sandwich-like between thin slices of bread. The best comes from that city of numerous aliases which is known, just at the moment, as Leningrad.

Orange marmalade is not known in Spain, where instead they use the quince. That from the Plata is well known in Latin America. In Cuba a marmalade of glass-like transparency—a semi-solid like guava jelly—is now produced from the orange.

So much for marmalade; let us change the subject to beans. Those big fellows known in the British Isles as broad beans are never exported; but our Italian colonists import a still bigger variety by the hundreds of tons. They are always in the dry form; and, dry, some of them approximate the size of a half-dollar. This is probably the most economically worthy of all beans. It is tasty and nutritious; a modest-sized plate, cooked and buttered, with a piece of bread and a glass of milk, will form a square meal.

Our own farmers might profitably grow these beans right here; the more so, since many of the imported big beans are infested with borers of one sort or another, which in this way get rooted in American soil. We have enough domestic plant-pests without bringing in any more from abroad to plague our farmers.

Left: Pistachio nuts from Asia Minor, in their varicolored husks. *Center:* Rose-petal marmalade from China, the opening of which permeates the room with rose fragrance. *Right:* Strung okra, universally sold thus in Arab countries

Three more curious comestibles from near- and far-eastern lands

The pistachio is rated among the choicest nuts of the universe. A picture is shown of the fruit in its natural reddish husk. Americans are best acquainted with this nut salt-roasted, but the Arabs prefer it as it grows. It is an extremely pretty nut; its sun-kissed outer skin, covering the shell, shows the variegated color effects of ripening which we get to greater advantage in the apple than in any other familiar fruit.

Stringing food products for drying is universal in the near east, as witness the dried okra, of mucilaginous taste and nutritive value; and even small fish are strung for drying and imported thus.

The beeswax-coated and cured kaviar from Stamboul, Greece, and other near-east points, is made from the roe of the mullet. It is a most creditable product, ever cleanly to handle; and, as imported in square boxes, looks like a mass of flattened-out

bananas. "There's a reason" for kaviar in its highly concentrated nutritive value. The tradition persists that it is a brain food of great worth, but this is, of course, in the same class with the same yarn about fish in general.

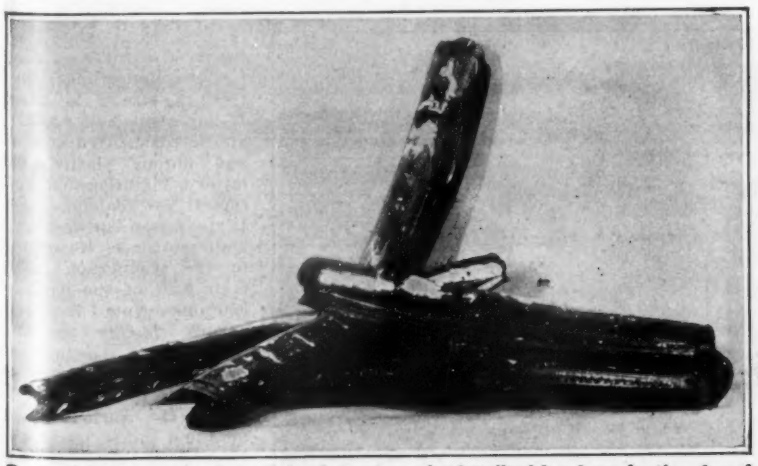
The shellfish known as sea urchins and razor clams are familiar sights around New York's Mulberry section, but are of little economic worth. The same Italian stores that handle these sell the bullfrog legs—some as fat as a plump baby's arm—so big that one might be pardoned for refusing to believe that a frog's leg ever attained such size.

Of the hundred or so queer types of bread which the world knows, the Arabian bread sheets are the strangest. A compost of wheat flour and raisin sirup, just sun-dried, these can be kept for years.

Many of these items can be got either in the bakery restaurant or in the foreign grocery store. The *carot au jus* (carrots, stewed in their own juice), however, is available only in the French bake shops, since the cooking is the whole story here. Only the French chef seems to know the secret. Brillat-Savarin prized this dish highly. It is little known that this famous epicure passed a couple of years of exile in New York and Connecticut in 1794-96. While in Manhattan he became so run down financially that he had to play in the orchestra of the Terpsichorean establishment that backed on Theater Alley and gave this little cranny in down-town New York its name. He returned to France after the death of Robespierre, and in later years wrote a charming account of life and hospitality in the Connecticut valley of 130 years ago.

Let no reader who can possibly find the French *carot au jus* omit trying this delicacy once in his life. I first met it in a French restaurant in Buenos Aires, some 40 years ago, made by a chef from Pau, who had a long tradition of service to distinguished French epicurean families behind him.

These food curios of all nations, many of which have been illustrated in these pages during the past decade, might have a commercial value for American food stores as window displays. As there are hundreds of these articles available at all times among the stores of the foreign colonies, the would-be collector has a large field of choice. Exhibits which are likely to cause the passer-by to stop with the exclamation "What is that?" would include the ripened jet-black duck eggs of China; the dried and spitted clams of Japan; the desiccated oysters of Canton; the brick tea of Hankow; the blood bread of Finland; the chocolate paste of Italy, done up in sausage skins; the haggis of Scotland, looking like a boxing glove; the snow-white lard sausages of Sicily; the white strawberries of France; the apricot sheeting of Turkey; the dried beef in sheet form of Latin America; the barley-bread disks of the Scandinavian countries; the raw-sugar canes of the Amazon; the cassava-bread wafers of the Antilles—and so on through scores of others. Those mentioned have the merit of being keepable for long periods—some of them indefinitely; and all of them have been illustrated in previous contributions from the present writer.

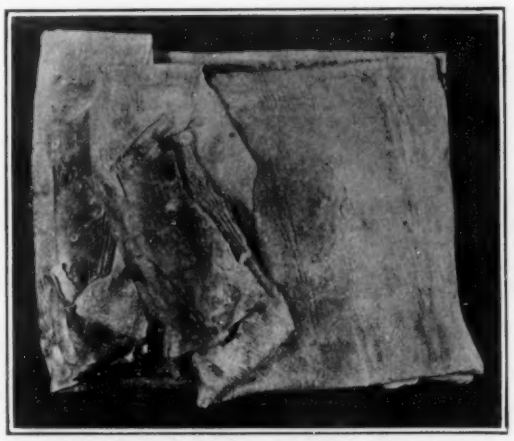


Razor clams from the Long Island coasts, a foodstuff of local production found exclusively in New York's foreign colonies

Face to Face with Vitamin D

FOOD chemists have known about the several vitamins since quite a few years, but Doctors Eddy, Kerr and Williams of Columbia University are the first who have seen any of them. Vitamin D, sometimes called "Bios," has just been isolated, seen, handled, analyzed and observed by these men. This member of the vitamin family is the one without which you are in danger of having rickets. We have known not all, but quite a lot about Vitamin D; but like the electrons and atoms, not to speak of the molecules, we had never seen it. However, it isn't always necessary to see a thing in order to make use of it. Rockefeller has never seen all of his wealth. Henry Ford has probably tried very hard to. Nevertheless, both of them continue to make efficient use of it. So with the vitamins. What good is it, to know that Vitamin D when isolated is a crystalline, white substance which looks like a dose of quinine and which on analysis shows an approximate empirical formula of $C_{28}H_{44}N_2O_2$? You cannot eat it straight. If you do, according to Dr. Kerr you will regret it. It can't be made into a patent medicine—or rather it probably could (anything can), but the three chemists who have just isolated it say they don't intend either to license the process of manufacture to anyone or to make it for sale themselves. It is not, in short, an end in itself, but more of a means to an end.

That end is, in a general sense, the complete knowledge of foods and how life is supported. The physiological chemists hope to be able to show some day that



Not a textile product—merely sheets of bread from Arabia. In life it looks more like parchment than anything else

life is simply a chemical process. They do think, and past experience supports them, that such a piece of knowledge as that gained by isolating Vitamin D is pretty sure to be useful in more ways than would at first appear. There is little waste in the output of scientific investigation. Seemingly useless by-products of information gained turn up useful in all sorts of future ways. Having isolated one vitamin they will try to do as much for the rest. Then with that as a lever they will pry off more knowledge about nature. That is the way advances are made in the world of science.

A few years ago students of foods were enthused about calories. Some went so far as to try to live on them—that is, they weighed out their foods and approximated a perfect daily quota of calories. They also talked a great deal about calories and some people who were forced to listen grew tired of it. One who enjoyed eating and who let his appetite be his guide was under the persuasion that some of the calory eaters were accustomed to take a secret "nip," as it were, of just plain food between meals when nobody was looking. But now it comes out that they had been ignoring vitamins. Calories notwithstanding, it is now known that the reactions which go on in the test-tube are not necessarily those which go on in the stomach; and that you might eat exactly enough calories and starve. Further

The largest beans in the world—habitat, Italy

than that, you might get scurvy or rickets or neuritis or even beri-beri. In other words, these diseases may result from vitamin starvation. For a long time vitamins were too mysterious, too elusive for the chemists to catch. But they did find out that without certain foods you might have these troubles, or some of them, and they reasoned backwards that these foods contained vitamins. Now one of the four or five known vitamins has been isolated by the Columbia University experimenters named, and we find that in 40,000 parts of growing years there is only one part of Vitamin D. But this vitamin is the one which stimulates growth and it is the lack of it in the human dietary which produces rickets.

Meteorites

IT appears to be almost certain that meteorites constitute the heads of small comets. The very minute particles that trail along after the heads of large comets, constituting in part the tails of them, on being heated to incandescence and dissipated by friction with the air, produce the phenomenon of "shooting stars," several of which anyone may see cross the heavens on almost any clear night. This meteoric material is known to be traveling at very high velocities—some of the larger masses at rates as high as 26 miles per second, and some of the dust-like particles at rates as high as 45 miles per second.

Now calculation develops that 26.16 miles per second is the "parabolic velocity" for celestial visitors to our solar system, that is, it is the maximum velocity that a body falling towards our sun can attain by the time it reaches the distance from the sun of half the diameter of the earth's orbit, even though it may have been falling from the utmost confines of space. In other words, a body may have been falling towards our sun from so far away that it has been falling forever, yet this is a velocity that, at the distance of the earth from the sun, it cannot exceed. Noting this accord between the common velocities of meteorites and certain comets, astronomers were formerly disposed to look upon all meteorites and comets as originally extraneous to the solar system, having been attracted into it from very remote distances. Quite recently, however, Professor Stroemgren, royal astronomer of Denmark, as the result of mathematical investigations made on comets for the last 22 years, seems to have refuted this old idea that comets (and presumably meteorites also) are "vagrant wanderers from interstellar space," by proving that those with elliptical orbits have always formed a part of our solar system.

Granting the thesis, then, that meteorites (and comets) have always formed part of our solar system, what has been their history within that system? A partial answer to this question is to be found by a study of the structure of meteorites. It is quite certain from such study that they have not always been cold bodies flying through solar space, but must have at one time been molten and subsequently cooled under great pressure. This is evidenced by their coarse crystalline structure and their occluded gases. Even CO_2 in a liquid condition in minute cavities has been found in some of them. Such facts can be accounted for only on the theory that meteorites (and comets) once formed the interiors of large planetary bodies or of a former sun.

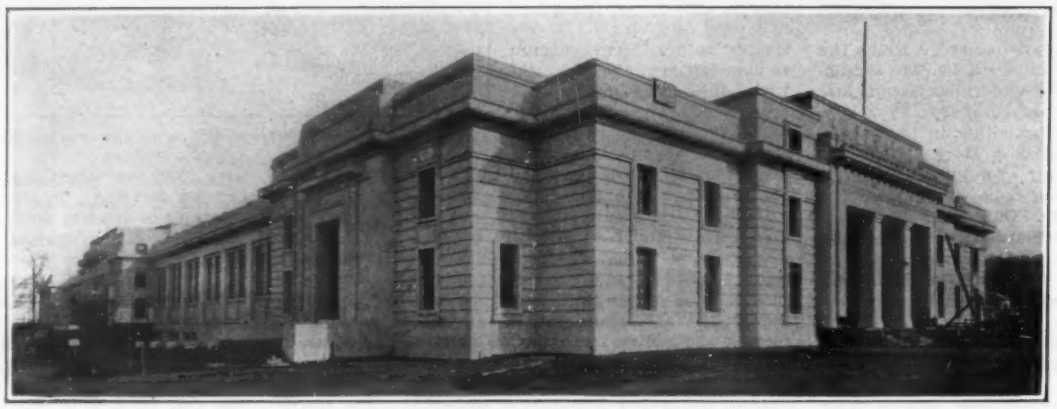
Now all these facts harmonize well with the Chamberlin-Moulton theory that our present solar system is formed out of the wreck through "tidal disruption" of a former solar system, the disrupting agent being another and much larger sun, in proximity to which our former solar system at one time came. In accordance with this theory meteorites are fragments of this former solar system—planetesimals out of which our present solar system is still being built.—*Abstract from the Scientific Monthly, Nov., 1923, article by Professor A. M. Miller.*

The British Empire Exhibition—II

The Colonial Buildings and Exhibits for India, Australia, Canada and New Zealand

By J. B. C. Kershaw
Our Special Correspondent in Great Britain

IN THE previous article (see SCIENTIFIC AMERICAN issue of August) the three larger buildings erected in Wembley Park for the British Empire Exhibition were illustrated and described. In this second article the buildings that have been erected by the Overseas Dominions and Colonies will be dealt with; and some preliminary notes will be given relating to the World Power Conference, which is to be held during the first fortnight in July. A full report of this conference will appear in a subsequent issue.



The Australian pavilion, second largest building on the grounds, covering 5½ acres

The pavilion which has been erected by the Government of India at an approximate cost of $900,000, covers three acres of ground, and reproduces some of the artistic beauties of the famous Taj Mahl at Agra, and of the Jama Masjid at Delhi. The pavilion is constructed of steel and fibrous plaster, and is flanked by two minarets 110 feet high. An imposing white dome rises above the main gateway; and in front of the main pavilion is a sunken courtyard surrounded by an open colonnade. The artistic effect obtained by this form of construction is considerable, and the Indian pavilion ranks with the Burmese as the most striking of the whole exhibition. The metal work, carpets, curtains, carving in wood and ivory, and all the other miscellaneous arts for which Indian craftsmen enjoy a world-wide reputation, are displayed in this pavilion.

Another interesting exhibit is the diagrams and models showing the activity of India's ports; visitors can thus see at a glance the volume of trade carried on by Calcutta, Bombay and Karrachi, and how the transport problems of the East are solved. Indian timber and its uses, forms the subject of another particularly attractive display, organized by the Indian Forests Department. Many of the Indian princes have taken space and show the varied resources of their own States, on a scale never attempted before. Models are also exhibited, showing the famous Khyber Pass, and the other parts of the Indian frontier, where border campaigns have been carried on in the past. An Indian luncheon and tearoom have been constructed among the trees on the north side of the pavilion; and an Indian theater completes the attractions of this very interesting section of the exhibition. We regret that the demands of space have resulted in crowding out the very interesting photographs of this building and the exhibits housed therein.

The Canadian pavilion forms an imposing building in the Neo-Greco style, on the south side of the Palace of Engineering. It covers about the same area as the Indian pavilion, and was erected at a cost of over a million dollars. Here a complete range of the natural and manufactured products of Canada is shown. Agricultural exhibits naturally form one of the chief features of this pavilion; and great skill and judgment have been exercised in the attractive arrangement of these exhibits.

The exhibit of mineral specimens represents practically every producing mine in the Dominion, and

The imposing structure in which the products and resources of Canada are displayed

specimens of all the woods grown in Canada, are shown in the forestry section. Horticulture is represented by a varied display of both fresh and preserved fruits, which are set out in a typical Canadian orchard, illustrating the methods of cultivation used out in the West. Specimens of all the leading goods manufactured in the Dominion are arranged in another part of the pavilion; and from this display visitors to the exhibition will be able to judge of the vast strides which Canada is making along industrial lines.

On each side of the main building are the smaller pavilions, containing the exhibits of the two trunk railway systems covering the Dominion from east to west. These illustrate the remarkable transportation system which Canada has developed, and give all possible information concerning the attractions the Dominion has to offer, both to the tourist and to the prospective settler and capitalist.

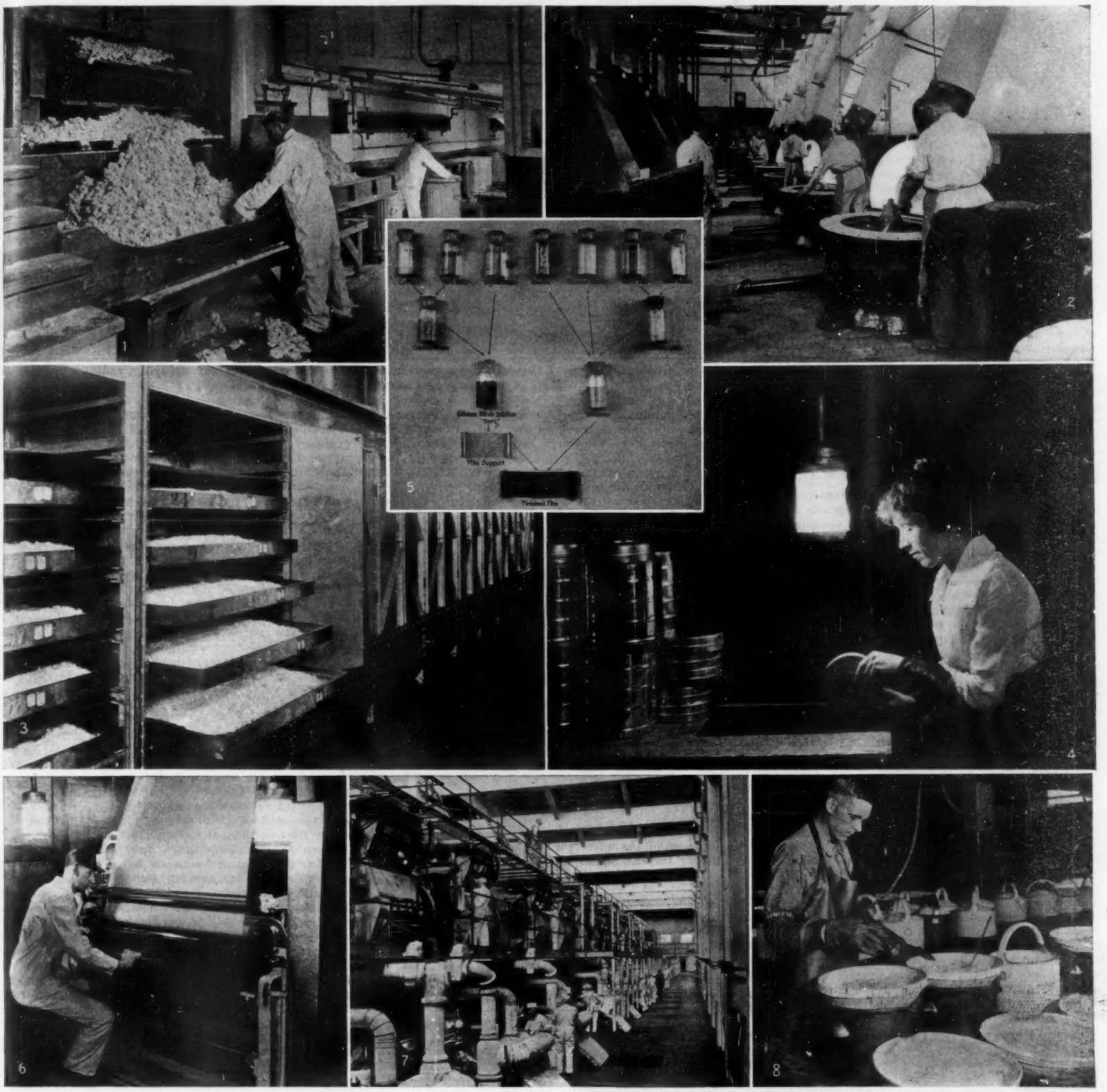
The Australian pavilion is, with the exception of the Palaces of Engineering and Industry, the largest in the exhibition, for it covers an area of approximately 5½ acres, and has cost over one million dollars. It faces the Palace of Industry on the south side, and can be reached directly from the latter by crossing the lake. The resources of the vast and still largely undeveloped continent of Australia are illustrated by actual exhibits. Thus 50 of the famous Merino sheep are exhibited alive in the grounds, and there are periodic sheep-shearing displays in the pavilion. The principal sections are devoted to the products of pastoral industries, dairying and fruit-growing, and the Australian wine industry; but forestry, cereals and cotton, manufactures, mining, shipping and transportation, are also well represented by attractive exhibits. A cinema theatre capable of seating 500 people will also be found in this building; and in this, films illustrating the life and industries of the Commonwealth are shown continuously.

A large cold storage is another feature of the pavilion, and here Australian refrigerated products, butter, meat, eggs and poultry, are shown. The Commonwealth Bank of Australia have opened a branch and attached to this is a reading room, in which Australian newspapers and literature relating to the country can be read by visitors. The grounds surrounding the pavilion are laid out with Australian plants and trees; among them is a large number of the wonderful tree-ferns which often attain a height of twelve feet.

The $400,000 edifice that emphasizes New Zealand's distinction from and independence of Australia

The pavilion of New Zealand flanks the lake on the west of the Australian pavilion, and is about one-third the size of the latter. It has cost about $400,000 and is constructed of steel and fibrous plaster, the latter being decorated with typical New Zealand scenes. It possesses an imposing main entrance, illustrated in the photograph. The main hall of the pavilion contains New Zealand natural history exhibits, tourists and sporting trophies; while the remainder is divided into sections, in which the various products and industries of the Dominion are shown. These include meat, dairy

(*Continued on page 222*)



IT was not until 1889 that George Eastman succeeded in making the celluloid photographic film practicable, thus paving the way for present-day amateur photography and motion pictures. The making of photographic film has expanded by leaps and bounds, until today the leading film-manufacturing plant produces in excess of 65,000,000 feet of motion-picture film per month or, roughly, 150,000 miles per year, not to mention the usual amateur photography film. Into the manufacture of this and other film goes nearly 5,000,000 pounds of cotton per year, and into the sensitizing, over three tons of pure silver bullion every week, or one-twelfth of all the silver mined in the United States.

The film base is a cellulose product. The first process in film making consists in washing and treating cotton in large rotary vats, and then drying the cotton in huge driers (1). Then follows the nitrating of the cotton (2) in the nitrating centrifugals, followed by washing and wringing. And now the cotton is ready for the solvents. It is fed into the "mixers" where large paddles churn the cotton and the solvents together, until a viscous liquid, known as "dope," is obtained. This "dope" is passed on to the coating machines, on which sheets 2000 feet long and 3½ feet wide are formed. These sheets, when dry, form the celluloid base on which the emulsion is spread (6).

Meanwhile, the emulsion is being prepared for the film. Here we start with silver bullion, which is dissolved in dilute nitric acid to form silver nitrate. The white crystals are stored in drying trays (3). The compound sensitive to light, known as silver bromide, is formed by mixing these nitrate crystals with potassium bromide and gelatine, dissolved in hot water. This gelatine solution, known as the "emulsion," is spread on the film in emulsion coating machines (7). This coating is, of course, a dark-room operation. The film is then cut into strips, examined (4), spooled and packed for shipment. The graphic story of film manufacture is shown ment. Figure 5 shows the graphic story of the whole process of film manufacture, in terms of the raw materials employed, their places in the cycle, and the various intermediate products obtained.

FROM RAW COTTON AND SILVER BULLION TO YOUR SNAPSHOT: PHOTOGRAPHIC FILM IN THE MAKING

Speeding Up the Sluggish Cables

Wired Wireless and a Re-Designed Morse Alphabet for Submarine Cable Communication

By S. R. Winters

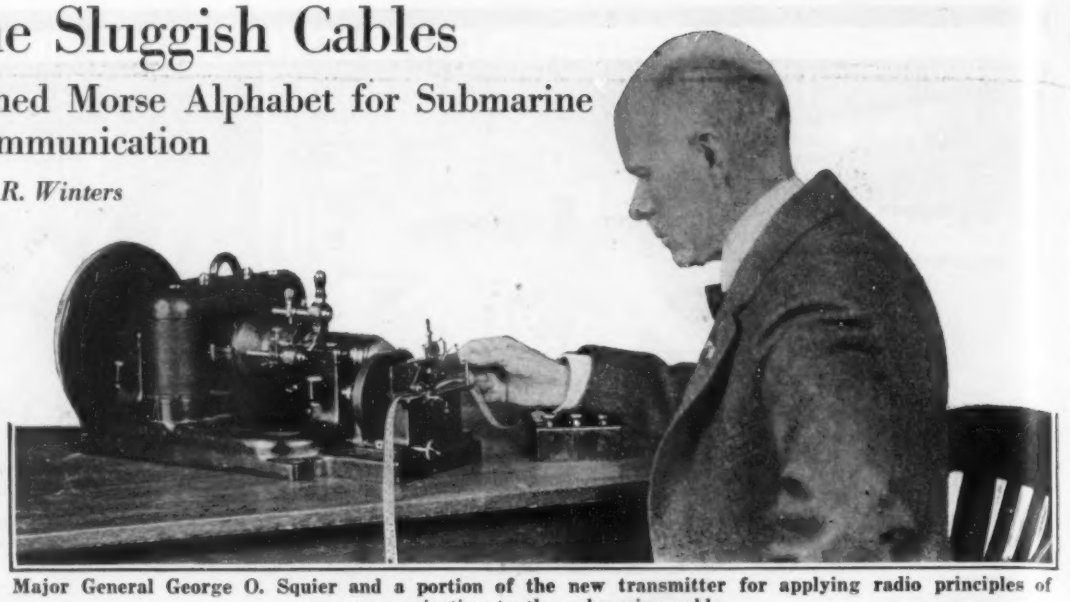
THE APPLICATION of line radio or "wired wireless" to the sending of communications by submarine cable has been experimentally undertaken by the Signal Corps of the War Department on a cabling system from Seattle, Wash., to Ketchikan, Alaska. This new use of radio was disclosed in an address by Major General George O. Squier, former Chief Signal Officer of the United States Army, at the annual meeting of the National Academy of Sciences, in Washington, D. C.

Experiments conducted during the last 12 months by William M. Bruce, Jr., cable engineer of Springfield, Ohio, have resulted in the development of a new type of code alphabet and a transmitter for sending this modified Morse alphabet by cable, land-line, or radio. The vacuum tube, the heart of radio broadcasting, will figure conspicuously in submarine cabling by radio since amplification of the cable signals will be obtained in this manner. Moreover, this departure in applying radio to submarine cabling contemplates a substitution of gutta percha in the construction of cables for a recently developed material, known as "permalloy." This is said to increase the speed of transmission and insure multiplex sending in cabling.

The revolutionary proposal which General Squier advances for modifying the Morse telegraph alphabet, briefly explained, is as follows: The sending of the telegraphic code is, by this new system, effected by varying the intensity of the three elemental signals instead of the transmission of dots, dashes, and spaces, as practiced at present. Moreover, this new alphabet proposes to invade the unused infra-audio range of frequencies, which would add a useful band of wave lengths which are at present unutilized because they are below the range of the human ear.

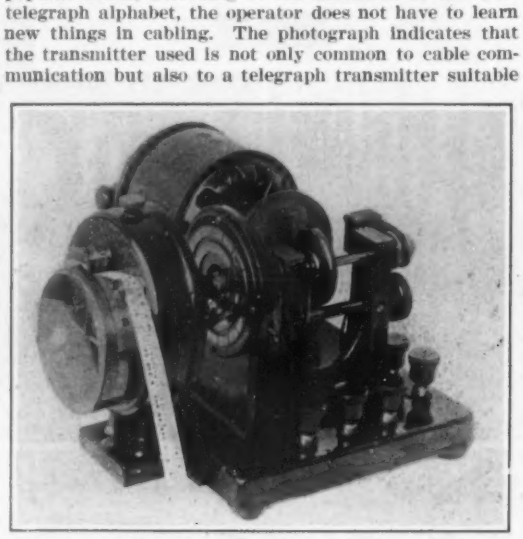
The first problem in adapting this code system to cabling was the development of a transmitter capable of automatically sending this radio type of alphabet. This has been accomplished, and the device is shown in the accompanying illustrations. In fact, the only necessary change in the type of cable transmitter in use for years was to provide a mechanism by which the battery now used in sending square-topped waves of the Morse alphabet could be adjusted to the transmission of the dots, dashes, and spaces in varying amplitudes. That is to say, the code is reduced to a common time element and the dots, dashes and spaces are distinguished by varying the intensity of the signaling.

The mechanism added to the ordinary cable transmitter consists of arms which revolve clockwise, causing brushes to pass over electrical resistances of certain values in order to generate a sine-wave type of electromotive force, which changes the amplitude of the dots, dashes, and spaces. A complete revolution of these arms produces a complete cycle, and the disk, four inches in diameter, is mounted vertically. The shaft of the motor which drives the tape carries two brushes which rotate with the shaft and contact with the segments. This makes for harmony between the movement of the transmitting tape and the battery.



Major General George O. Squier and a portion of the new transmitter for applying radio principles of communication to the submarine cable

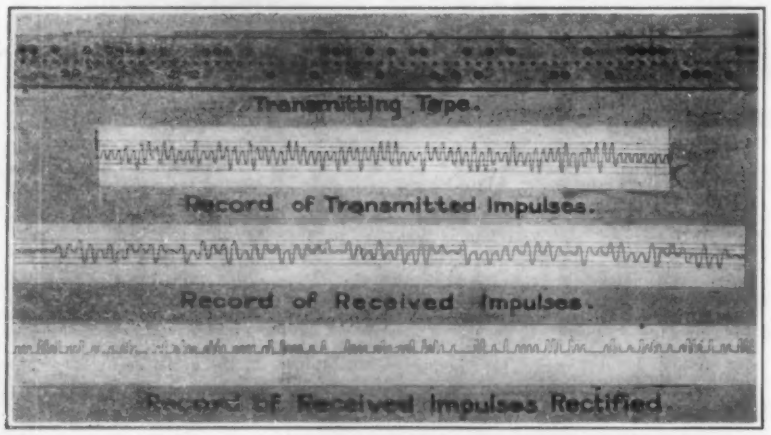
The amplitude of the semi-sinus of the alternating current is under control by the two adjustable electrical resistances, previously referred to. Contrary to popular belief, according to the inventors of this new telegraph alphabet, the operator does not have to learn new things in cabling. The photograph indicates that the transmitter used is not only common to cable communication but also to a telegraph transmitter suitable



Close-up of the universal automatic telegraph transmitter for the Squier alphabet, available for use in radio, land line and submarine cable

for radio and land-line circuits. The change, in order to meet the needs of the modified Morse alphabet, in space radio means the use of certain resistances by means of which the dot, dash and space contacts at the transmitting tape will give different modulating frequencies instead of a variation in the amplitude of the carrier frequency. In space radio, the inventors admit, this change of amplitude would not operate satisfactorily due to fading. Then, too, for ordinary radio through the ether, radio-telegraph signals may be readily distinguished by change of frequency.

"Present cable operation may be compared to a patient who has been doctored for many years and now requires a major operation to start him on the road to complete recovery," picturesquely remarks Major General Squier. "This operation consists in redesigning the alphabet itself according to the latest engineering practice in the radio art." He goes on to show that the present Morse alphabet transmits the five letters, A, C, K, N, and R, with a single fundamental frequency of alternating current. On the other hand, the five letters, H, I, M, O, and S, are sent with double the frequency of the group of letters previously referred to. Thus, according to the former Chief Signal Officer of the United States Army, the speed of the entire traffic of ocean cabling has been blocked by five letters and by reasons of a faulty design of the alphabet itself.



The mechanics of the new Squier alphabet, showing the transmitting tape and the successive steps in the transmission and reception

The new alphabet, where speed is a peculiar virtue, involves the use of a transmitter in such a way as to impress upon the cable a continuous modulated wave of voltage or electric current of a definite fundamental frequency and wave length. This wave is modulated at the zero phase of the resultant current flowing into the circuit. This varies the amplitude of the individual half-cycles in three stages, representing dots, dashes, and spaces, the elemental units common to the international Morse telegraph code. The relative values of these changes are under the control of the cable operator and may be adjusted to meet the needs of the particular cable used. In the case of the cable, for instance, the desired condition is when the three amplitudes are of equal value. This resolves itself into the illustration of power transmission by alternating current. Thus, the speed of sending of the equal signals is multiplied many times. That is to say, the speed is all that could be desired without regard for the frequency, the voltage, or the length of the cable.

The vacuum tubes for amplifying signals transmitted by cable will be used successfully for the first time when the modified Morse alphabet is operative. The modern Aladdin lamp which now boosts weak signals in your reception of broadcast music and speech, will be employed in amplifying signals going across the Atlantic Ocean, perhaps, by submarine cable. Although previous attempts to use the vacuum tube in amplifying signals received over an ocean cable have not been successful, Major General Squier says "In the key plan (referring to the new alphabet), this powerful instrumentality, which has done such wonders for broadcasting, should logically take its place as one of the vital steps in the reception of long submarine cable signals. Enough has been said," continues General Squier, "to indicate that the cable engineering of the near future will include amplification, probably in several stages, of the sub-audio signals received."

The necessity for discarding from the present cable circuit any make-and-break transmitter is urgent, according to the inventors of the modified Morse alphabet. In its stead, it is argued, should be introduced the new transmitter which produces a smooth continuous wave form of modulated alternating current. The present method of sending code, based upon different time elements for dots, dashes, and spaces, according to the inventor of the new alphabet, means that the cable is disconnected from the battery at both ends at least six hours a day. This seeming waste of time, is necessary to drain the cable of excess electrical charge in order that the communication system will function the remaining 18 hours of the 24.

All of which prompts Major General Squier to remark: "After over half a century of experience with ocean cables, during which time every refinement has been introduced that skill and ingenuity can device, we are at present entering a new phase of cable development which will give ultimately a speed and accuracy unthought of at present."

Camera to Photograph Cylindrical Surfaces

THE Bureau of Standards has for a number of years been carrying on tests on the corrosion of buried pipes. Short lengths of pipe, with and without protective coatings, have been buried in various kinds of soils in different parts of the country and dug up after a time to determine the extent to which they had corroded.

As an aid to recording the extent of corrosion of these specimens, Mr. R. Davis, the head of the photographic laboratory, has constructed a camera which photographs at one operation the entire surface of the pipe. The film is moved past a slit in which an image of the pipe is formed, being driven by an electric motor. The film driving drum is connected by a belt to the shaft on which the pipe revolves and the camera is so arranged that the turning of the pipe caused its image to travel with the same speed as the film and in the same direction. An automatic switch stops the motor and closes the shutter after pipe has made a little more than one complete revolution. The shutter is always open while the motor is running. In our photograph, the driving motor is on top, and the pipe specimen on the right in front of the lens.

Home of James Watt Purchased

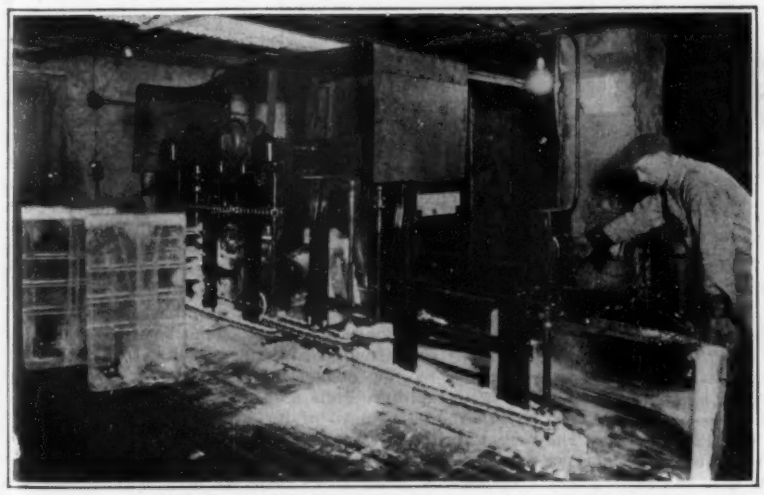
HEATHFIELD HALL, Birmingham, the home of James Watt, with surrounding grounds has been acquired by a syndicate who intend to develop the estate for the erection of private residences. Watt planned the shrubberies and gardens, and many of the trees were planted by him. The garret was fitted up as a workshop, and there the great engineer continued his mechanical studies and experiments for many years after his retirement. The room remains in the precise condition in which it was left by Watt.

Scoring Ice by Machine

ICE-DELIVERY, under the old-fashioned technique, is not a very precise or satisfactory business. There is always more or less haphazard guess-work on the part of the driver, short weight or long weight, and loss of time in the estimating, handling and cutting of the ice from the wagon. An escape from this state of affairs is now offered by an ice-scoring machine, which makes it impossible for wrong weight to be given, save by blunder, and which results in great increase of the territory covered by one driver.

The capacity of this machine is four blocks per minute. Its height is 5½ feet, its width 31 inches and its length 13 feet. It takes the large blocks of ice on edge, scores them lengthwise, heads them up, scores them crosswise, and discharges them standing on end. The operation results in a scored border along the edge of each piece of ice, and this border is the customer's guarantee that he is getting full weight.

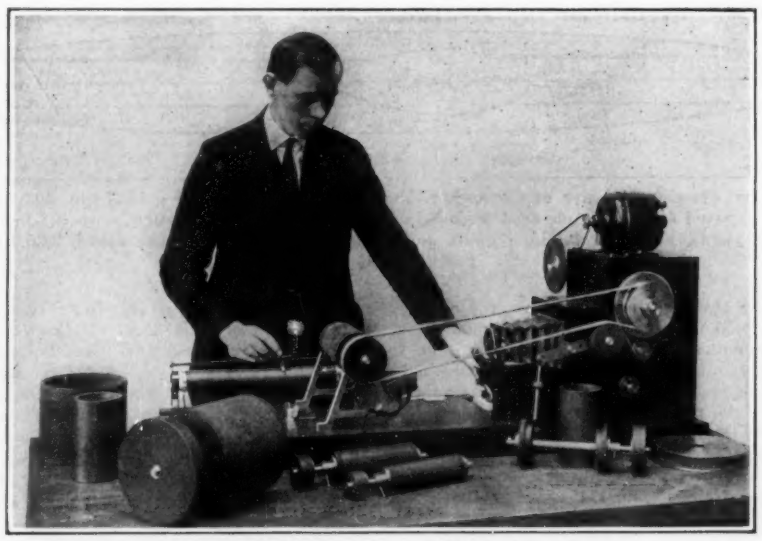
Ice so scored must be cut into full 25- and 50-pound sizes and must be cut along the scored lines. The random subdivision, by the driver, of a 200- or 400-pound cake into pieces which he hopes are of 25 or 50 pounds, by the chopping method, is eliminated. By no means the least advantage is the greater possibility of a driver's covering his route on schedule, and delivering to each house at the same hour each day. Moreover, the biggest platform rush can be taken care of with speed and efficiency if the ice is machine-scored in advance.



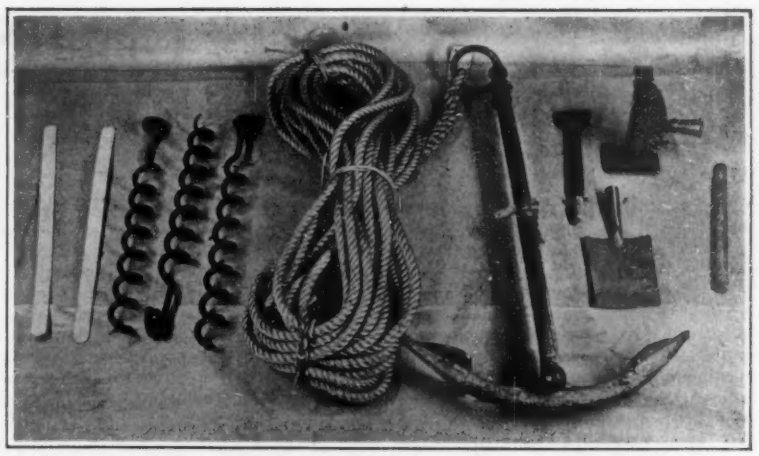
Machine for scoring ice in 25- and 50-pound sizes

Chemical Analysis by X-Ray Spectra

IN a paper read before the Deutschen Bunsen-Gesellschaft, Dr. D. Coster shows that the relations between the X-ray spectra of the different elements are so simple that, in some respects, they are more useful for purposes of chemical analysis than ordinary luminous spectra. An important advantage is the fact that the X-ray spectrum of an element is quite independent of the nature of the compound containing it. It is easy to detect the presence in a mixture of which not more than one mg. is available. Certain precautions are necessary in examining the X-ray spectra; although the number of lines for each element is comparatively limited, recent observations have shown the existence of a number of weaker lines; in addition to this, with the high voltages now generally used, not only the spectrum of the first order, but also those of higher orders appear. Slight impurities in the material of the anticathode, and in the substance under examination, also give their lines, so that there are often various possibilities to be considered before a given line can be explained. Not only the wave length, but also the typical appearance of the suspected lines must be considered, as well as their relative intensity. By measuring photometrically the intensity of the spectral lines it is possible, in some cases, to obtain a quantitative estimate of the amount of an element present in a mixture.



Camera for photographing cylindrical surfaces



Anchor, rope and corkscrew stakes which the American aviators carried around the world with them, to insure keeping the plane in place on the ground in the highest winds

Landing Gear for the Round-the-World Planes

THE problem of holding an airplane in place upon the earth is often as great as keeping it in the air. To meet this difficulty airplanes that alight upon the water carry anchors and those that land upon the ground carry stakes. When a flight leads over both land and sea as did the route of the American airplanes flying around the world, both anchors and stakes are carried.

Special equipment was stowed aboard the round-the-world airplanes which is designed to meet any ordinary emergency. This included anchors, spades, jacks, corkscrew stakes, tire irons and so forth. The anchors were tested before the start for holding on normal sandy bottoms of bays, and they were not supposed to drag except during a gale. Early in the world flight, however, a heavy wind caused one of the airplanes to drag anchor in the bay at Sitka, Alaska, but no damage resulted as a mechanic was in the ship when the wind struck and he started the motor and taxied to the shore. The anchors carried with these airplanes have 125 feet of rope, and in water deeper than this they are of little value except as a drag.

For use upon the land the world-cruising airplanes found corkscrew stakes which may be twisted into the ground like an auger, highly useful. The spade handle which is detachable may also be used as a lever to screw the stakes into the ground. All modern aviators in making long flights that necessitate keeping a plane outside a hangar at night carry stakes and rope to hold the airplane down. When a wind comes up, an airplane is easily overturned or blown away, and strong stakes are needed. The airplanes on the world flight can lift over 9000 pounds when propelled through the air at 80 miles an hour, and if a wind of this speed should blow, the entire plane would be lifted into the air unless it were staked down properly. One of these airplanes without a load weighs about 6000 pounds and in an 80-mile gale an upward strain of 3000 pounds would be exerted upon the stakes. Experience has taught that the best way to turn an airplane for staking is 45 degrees into the wind. In this way the lifting surfaces are least effective, due to the angle at which the wind attacks. Stakes are driven beneath each wing tip of an airplane and near the tail surface. The wing tips of all late model airplanes have slots for the stake ropes, but in tying down the rear, the rope is passed around the small part of the fuselage just in front of the tail surfaces and then made very fast to the stakes.

A jack and tire irons are also very necessary equipment for the round-the-world cruisers. These planes as well as all others will spend as much time on the ground as in the air, and besides, the greatest strain on an airplane is when it is brought into contact with the ground for landing. To blow out a tire on landing is a very common accident, and frequently tires are blown out with a loud report, while an airplane is in flight. This is usually due to sudden expansion of the air within the tire, and this expension results from the action of warm layers of air that airplanes encounter during flight.

When flying through Asia, the around-the-world aviators carried two extra tires beneath the fuselage of their airplanes to meet such emergencies mentioned, for the hot winds from the Indian jungles will cause quick expansion of inflated tires as will the burning sands of the Persian deserts. Airplanes can usually land safely with a blown-out tire, but it requires considerable skill at piloting in order to prevent one wing from digging into the ground. A hard landing blows more tires than anything else. Aviators call this "shooting a tire." The spades will be used on the world flight when the airplanes get stuck in the mud, which they will probably do on a few occasions in India and Turkey where muddy fields will no doubt be encountered.

Giant Submarines

What the Naval Architects are Doing in Developing Super-Submersibles

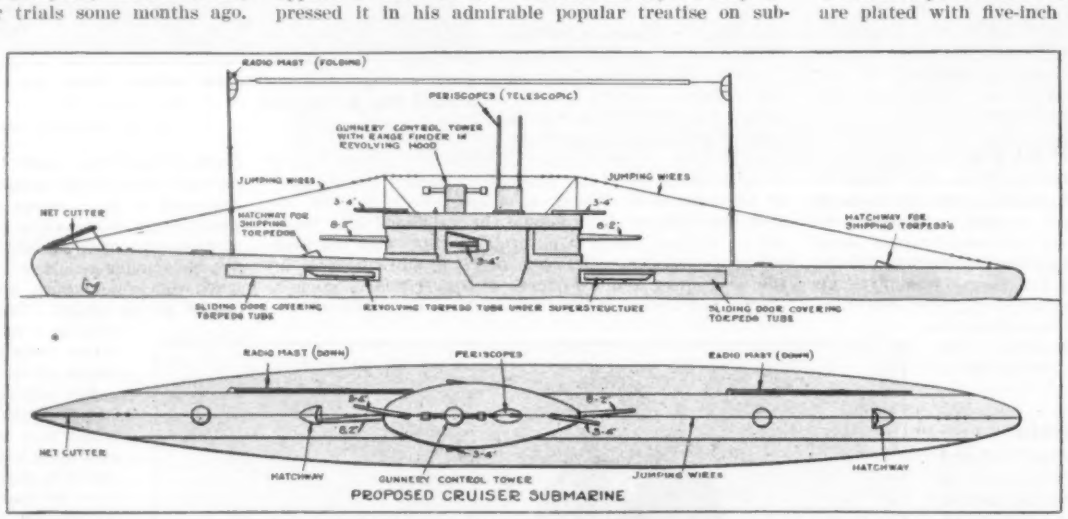
By Nauticus

CONSIDERING how relatively short a time the submarine has been in use as a serviceable instrument of naval warfare, the rapidity of its development is astonishing. The first British submarine, "Holland No. 1," was launched on Nov. 2, 1901. She displaced 120 tons when submerged. Twenty years later, to the very day, the keel of another British submarine was laid at Chatham dockyard, and this vessel, known as "X. I," began her trials some months ago. When it is mentioned that her submerged displacement is just 30 times as great as that of "Holland No. 1," some idea will be gained of the enormous strides which submarine design has made in two decades.

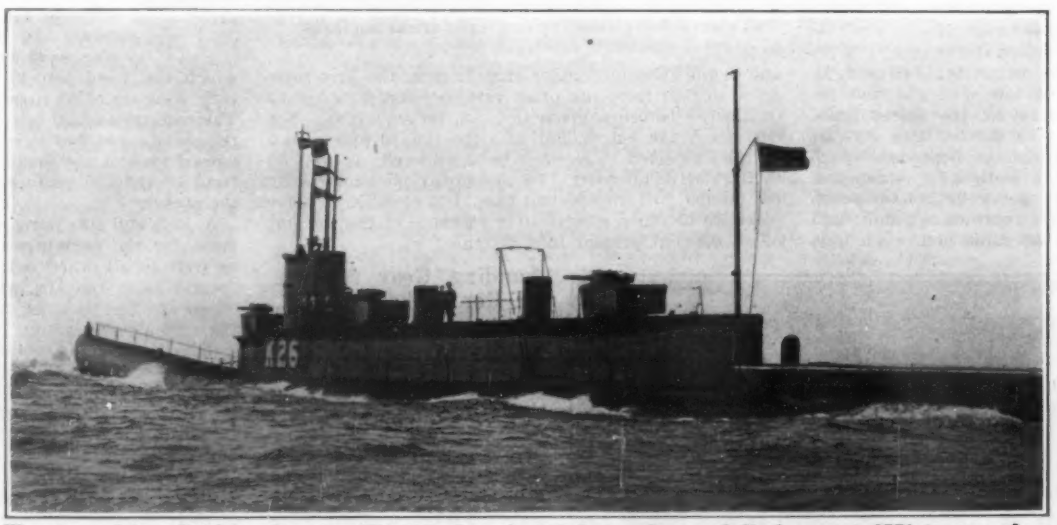
According to the official admiralty list, "Particulars of British War Vessels," "X. I" has a displacement of 2780 tons on the surface, increasing to 3600 tons when she is below water. For the moment, therefore, she is the largest submersible craft in existence. Next in order of size comes the "K. 26," a British steam-driven boat completed last year, displacing 2140 and 2770 tons respectively. If, however, submerged tonnage be taken as the criterion, "K. 26" is surpassed by the "Halbronn," an ex-German boat now serving in the French Navy, which displaces 1930 tons above and 3050 tons below water. The largest United States submarines actually building are the "V-1" to "V-3," officially stated to displace 2025 tons on the surface; but rumor speaks of the three "cruiser-submarines," included in the new shipbuilding program as vessels of 3000 tons. France has also decided to build submersibles of 3000 tons, two of which are to be laid down this year or next.

If Germany were not debarred by Treaty restrictions from building submarines, it is possible that the foregoing types, gigantic as they seem in comparison with the earliest boats, would be entirely eclipsed by the latest "Untersee-Kreuzer" of the German Navy. Professor Oswald Flamm, one of the ablest of German naval architects, who took a prominent part in the construction of the war-time "U-boat" flotilla, recently disclosed particulars of some typical designs which he has prepared. He claims to have solved "the most baffling of all problems in naval warfare—the problem of stabilizing the submarine." Early in the war, he tells us, it was found that if submarines were built of a size above the normal, or were equipped with protective armor, long-range guns, or even an extra supply of torpedoes, their stability suffered immediately. "The large submarines we built toward the end of the war often, in submerging, took a list to port or starboard of as much as 55 degrees, which naturally played havoc with the nerves of the crew and sometimes led to disaster." The nature of his new formula for stabilizing submarines without the aid of ballast or gyrostats he does not reveal. As all who are familiar with the rudiments of the subject know, the problem of stability is far more complex in the case of submersibles than in surface ships. In the latter, every addition to the weight, carried topsides, may be compensated by an increase in what is called "form" stability—that is, by increasing the beam of the ship in proportion to its depth. But since form has no effect on the stability of submarines when they are below the surface, this expedient is of no avail when applied to such vessels. As Mr. Marley F. Hay expressed it in his admirable popular treatise on submarine design, the only stability a boat possesses when it is traveling submerged "is derived from the fact that, as in a pendulum, the center of weight is below the center of suspension."

Nevertheless, without in any way impugning the originality of Professor Flamm's discovery, it deserves to be noted that foreign designers were able, during the war, to build thoroughly safe and reliable submarines which carried much heavier topweights than the German U-cruisers that proved so deficient in stability.



Recent design, by Flamm, designer of German U-boats during the war, for a 7067-ton, 403-foot submersible cruiser, whose exposed surface is covered with 5-inch armor. She would carry two 8.2-inch guns with a range of 17,000 yards, and four 3.4-inch guns, and 10 torpedo tubes. Surface speed, 22.5 knots. Cruising radius, 23,000 miles



The steam-driven British submarine "K. 26." Length, 340 feet; submerged displacement, 2770 tons; surface speed, 24 knots; armament, three 4-inch guns, eight torpedo tubes

The largest of these German boats was the "U. 142." of 2158 tons, which carried two 5.9-inch guns, the collective weight of these weapons, with their mounts, being about 20 tons. On the other hand, the British submarine "M. 1," built at the same period and displacing only 1600 tons, carries one 12-inch gun. The "M. 1," unlike "U. 142," is said to have showed no lack of stability, and has proved quite safe and satisfactory in service. These facts indicate that British naval constructors, as long ago as 1916, had tackled the stabilization problem with a fair measure of success, though perhaps not on the same lines as their German confrères.

Professor Flamm's latest design is for a submersible cruiser of 7067 tons surface displacement, with a length of 403 feet and 49-foot beam. The deck, the sides and the conning-tower, in fact the whole part of the vessel which is exposed when she is traveling on the surface, are plated with five-inch armor, representing a total weight of 614 tons. Her main armament consists of two 8.2-inch guns, each mounted in an armored revolving turret on deck. These guns, if of 50 calibers, would weigh 15¼ tons apiece without their mounts, and could throw 275-pound shells up to a maximum range of about 17,000 yards. Five hundred rounds of ammunition are provided for each big gun. There are also four 3.4-inch 60-caliber guns, firing 21-pound shell. Four torpedo tubes of a caliber not stated are fitted in the bow and four in the stern, with two more tubes on deck, having a wide arc of training. Provision is made for carrying 45 torpedoes. The vessel is propelled on the surface by three sets of Diesel engines developing 30,000 b.h.p. through triple shafts, giving her a speed of 22 or 23 knots. Her electromotors for submerged cruising develop 5000 horsepower. Sufficient oil-fuel is stowed for a continuous voyage of 23,000 sea miles at an economical speed of 11 to 12 knots. A crew of 100 officers and men is required to work the vessel, which can submerge in one minute. The second design is for a mine-laying submarine of identical dimensions and engine power, but carrying, instead of guns and torpedoes, the great load of no less than 1000 mines.

In view of the decided upward trend in the tonnage of post-war submarines, these particulars have something more than a merely academic interest. The British naval authorities have not communicated their reasons for building the "X. I," but it is assumed to have been designed in the first place for accompanying the battle fleet in the character of a "submersible destroyer," ready at the proper moment to dive and attack the enemy's line with torpedoes; and, secondly, for long-range reconnaissance. It would also be useful as a patrol ship on ocean routes liable to be menaced by enemy commerce destroyers. It is not known whether the "X. 1" is as fast as or faster than the 24-knot "K" boats driven by steam, but thanks to her Diesel engines she will have a much wider radius of action. Her armament is understood to be light in proportion to the displacement, consisting of medium-caliber rapid-fire guns and a number of torpedo tubes.

In the early days of its development the submarine was regarded essentially as a unit for coast defense, and was not believed to have any value for deep-sea operations. But times have so far changed that the

(*Continued on page 223*)

California's Foot-and-Mouth Quarantine

ONE of the most interesting angles of the fight waged in California by county, State, and Federal authorities against the foot-and-mouth epizootic, has been the mechanical.

Not only were Department of Agricultural officials, horticultural commissioners, and veterinary surgeons pressed into service, but contractors, carpenters, chemists, and engineers were employed in an effort to stamp out the disease in infected areas and prevent its spread into uninfected territory.

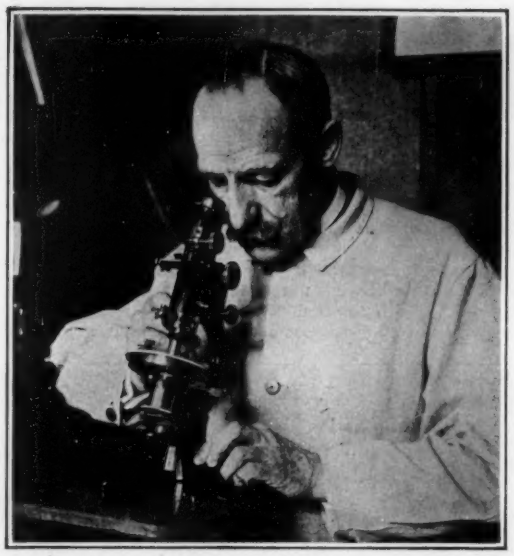
For example, huge trenches had to be dug in which to bury thousands of animals which were slain by authorities after they contracted the malady, dipping vats had to be built through which all automobiles leaving quarantine territory were forced to run, and disinfectant capes of rubberized material had to be used for humans leaving counties in the affected territory. And in the preparation of all disinfecting fluids and gases chemists were utilized to aid the veterinary.

The dipping vats for automobiles, placed at county lines, were built to accommodate any vehicle from a flivver to a five-ton truck. Into these vats a solution of bichloride of mercury of a ratio of about 1 to 1000 was poured. This solution thoroughly disinfected tires, wheels and the under side of fenders which are most likely to pick up the highly contagious disease.

In the case of the burying trenches for slaughtered stock, steam shovels were employed to dig trenches 9 feet deep, 20 feet wide, and in some cases 500 feet long. Into these trenches the infected cattle or other stock were driven, shot down, covered with quicklime, and buried, thus effectively preventing any further spread of disease by the infected herds.

In the case of humans who passed through close quarantine or provisional quarantine areas, rubberized capes reaching from throat to ankles were used and under them formaldehyde gas was generated for five minutes. In some counties passengers of automobiles and stages were forced to wade through the disinfecting vats for cars. Some counties used creosote solutions of from three to five per cent in these dipping vats.

A total of 48,596 infected animals from 378 herds had been slaughtered and buried in California up to April 17th. Of these, 25,447 were cattle, 10,204 hogs, 12,635 sheep, and 310 goats. The estimated appraised value of this stock was $2,034,437, of which the Federal Government pays half and the State half. One of the prize herds to be slaughtered included six world champion cows and was valued roughly at $500,000.



The microscope that uses the sun as a spotlight

New Ammonia Catalyst

A NEW ammonia catalyst has been developed by the fixed nitrogen research of the Department of Agriculture which brings about the permanent union of nitrogen and hydrogen and yields various proportions of ammonia according to the particular promoter used in the catalyst. The latter is described as a reduction product of iron oxide containing promoters. The promoters are also classified so that a selection may be made from them that will give any kind of catalyst that may be wanted, depending on operating conditions. For example, a yield of 14 per cent ammonia has been obtained by the use of catalysts, in the making of which 2 per cent of potassium aluminate is used as a promoter. Some promoters will give a greater yield of ammonia and some a lesser yield, but the former have not been practically developed as it is believed that they can not be obtained economically.

Making the Sun Help the Microscope

THE image of the sun may now be used as an aid to the microscope in clarifying obscure objects. Heretofore, in the making of microscopic observations the brilliancy of "Old Sol" has been too great for use by the naked eye, and to that extent hindered rather than helped in the magnifying of objects.

Now, thanks to a simple piece of equipment devised by Dr. N. A. Cobb, agricultural technologist of the United States Department of Agriculture, an effect similar to the use of a spot light in a dark room is employed with the microscope in its search for objects in a wide field of vision. This discovery was made while taking advantage of hazy days in the formation of the image of the sun on the tissues inside of the object being examined. This led to various experiments in attempting to duplicate the effect of the sun's peeking through a hazy atmosphere.

First, glass-walled boxes containing smoke, fumes of ammonium chloride, and water containing milk, were each used, in turn. The results were not entirely satisfactory in these instances. However, a large sheet of glass finely etched with hydrofluoric acid produced gratifying results. Deeply colored glass, green or blue, is especially adapted to this purpose.

The sheet of glass is placed between the sun and the microscope condenser, the combination revealing spots not otherwise made visible. It was found that the sub-stage condenser gave a very small image of the source of light, while a suitable condenser is an exceedingly high-power microscopic objective. The arc light, when so employed, is less effective than the sun.

Inverted Flight in Airplanes

A PAPER of considerable interest to practical aviators, as well as to workers in the dynamics of airplane flight, was read recently before the Royal Aeronautical Society (British) by R. M. Hill. The paper is entitled "The Maneuvers of Inverted Flight," and is based upon extensive experimental flights executed by Mr. Hill and others. The object of the experiments was threefold. The immediate aim was to examine the causes of fatal accidents that often occur in aerobatics on an unstable airplane, when the airplane assumes an inverted position and the pilot fails to right the machine. Subsidiary aims were to find the magnitudes of the loads in inverted flight, and to examine the behavior in inverted flight of machines with different stability characteristics. An account is given of the ways in which inverted flight can be obtained, namely, by means of the half loop and the half roll, and details of the maneuvers are given for particular airplanes. Belting arrangements are of supreme importance, especially in unstable fighting machines; pilots often fail to use the controls because they cannot reach them. Steady inverted flight is possible on all types of machines investigated; but whereas the longitudinally stable machine tends to right itself, the longitudinally unstable machine has no such self-righting properties; there is, however, no real difficulty in recovering from the inverted flight. The longitudinally unstable machine is also liable to get into an inverted spin, but here again the pilot can recover his balance. Mr. Hill suggests that "the best compromise between safety and extreme maneuverability is to be found in an airplane which, though preferably stable throughout the major part of its range of flying speeds with elevators free, must definitely be stable with them fixed."

Left: The vat used to disinfect cars passing from county to county. *Right:* Long enveloping rubber cape used in the disinfection of the clothing of people passing from infected to clean zones

Putting people and conveyances through the mill to insure against the transportation of the foot-and-mouth epidemic

Digging a trench for the disposal of the carcasses of infected cattle slaughtered by government action. This trench is 20 feet wide, 9 feet deep and 500 feet long; it will accommodate 1200 carcasses

Sanitary engineering on a giant scale

The Story of Steel—VIII

From the Ingot to the Finished Product—Rolling Steel Rails

THUS far in the story of steel we have described the successive processes by which steel is produced from iron ore. We have seen that the active agent in the production of steel is fire; first by the combustion of coke under hot air blast in the blast furnace to produce pig iron, and then in the fierce heat of the converter and the open-hearth furnace to refine the pig iron to steel, which is cast in the form of an ingot of from two to four tons in weight.

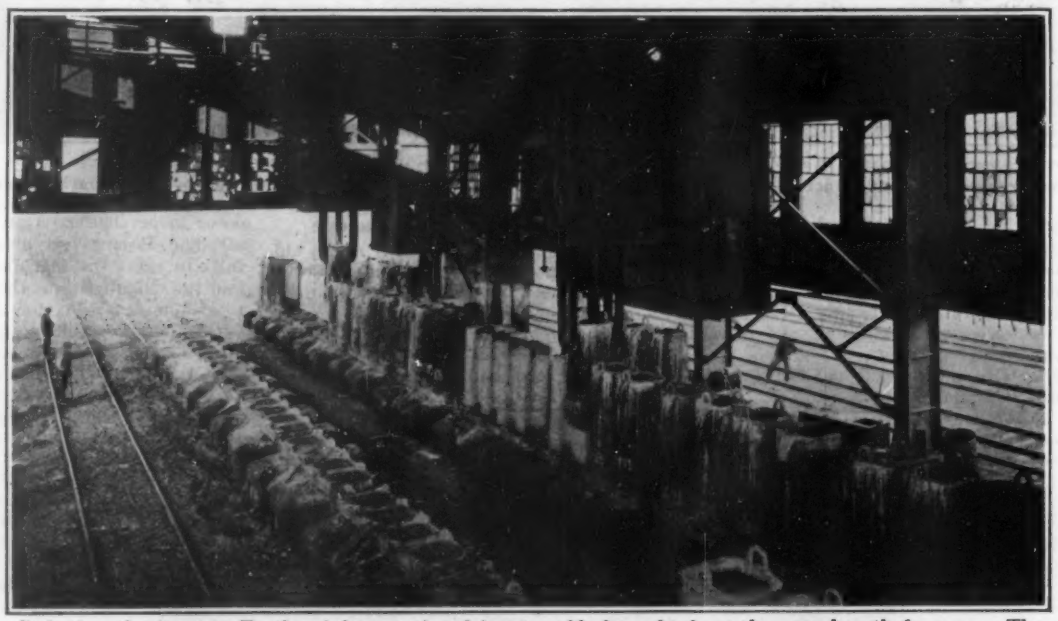
The succeeding chapters will deal with the manufacture of the steel ingot into some of the principal finished steel products; and as fire is the principal agent in the production of the ingot so we shall see that the steel rolls of the rolling mill, assisted by furnace heat, are the principal agent in shaping the steel ingot into the multitudinous finished forms of the steel industry.

It may safely be said that every one of us, at some time in our youthful days, has watched the cook take a lump of dough and roll it down to the desired shape with her rolling pin, and it is this simple process of which the steel manufacturer avails himself to reduce the bulky white-hot ingot to the desired size and shape—with this important difference, that in the rolling mills the work is done between two stationary rotating rolls, driven by powerful steam engines or electric motors.

Beneath each of these dome-like castings is a gas-fired "soaking pit" containing four ingots. In these pits the ingot is heated to the proper temperature for rolling into rails

The present chapter deals with the manufacture of steel rails; and regarding the rail let it here be said that, in the broad field of the steel industry, there is probably no single material that is called upon to perform such heavy and trying duty as the steel rail. It is subjected to every conceivable kind of stress, and practically all these stresses are heavily dynamic in character. In the first place, a 33-foot rail is practically a continuous girder having about 22 evenly spaced piers or supports—the ties. The loads which come upon it are heavily concentrated; they are imposed where the successive wheels of locomotive or train bear upon the rail. These loads, moreover, exert dynamic effects which are enormously increased if the track is not absolutely level or the ballast below is of uneven solidity. The weakest point in the stretch of track comes, of course, at the rail joints, where an attempt is made to restore the girder strength of the rail by clamping a pair of fishplates or angle plates against the abutting ends. Never is it possible completely to restore the strength at this point, and should the nuts or the bolts work loose, as they constantly tend to, the strength of the joint is proportionately reduced; it sags under the load and each wheel, as it thunders by, drops into a hollow and strikes a terrific blow against the end of the second rail as it passes over.

But this is not all; for the expansion and contraction of the steel under changes of temperature set up heavy tensional stresses throughout the rail; and, moreover, there is an insidious action known as creeping, in which the rail, because of its wave-like deformation under the load, is pushed and drawn forward against the holding power of the spikes and anti-creeping clips. There is also to be added the lateral stresses due to the side blows of the train, particularly when that curious lateral swaying motion known as "nosing," sets up, in which a massive locomotive, weighing frequently several hundred tons, sways from side to side, delivering heavy lateral thrusts against the head of the rail, tending to overturn it. And finally there are the severe abrading and crushing effects of the concentrated wheel-loads upon the head of the rail, due to the aforementioned pounding and to the heavy traction of the driving wheels and the retarding effect when the brakes are applied. In a word, the traffic is all the time endeavoring to crush the rail by compression, to tear it asunder by tension, and to twist it out of shape by torsional twisting forces or grind it away by severe friction.



Stripping the ingots. To the right a train of ingot molds brought from the open-hearth furnaces. The molds are being lifted, leaving the ingots on the cars, ready to be taken to the soaking pits. A pair of arms from the overhead stripping machines lifts the mold, while a central plunger bears down on the head of the ingot

To meet all the above attacks, therefore, the rail must be tough, hard, and moderately elastic, and it must possess these qualities so surely that the lives of millions of people flying along these two slight strips of steel must be so safe that accidents shall be only one to so many millions of people transported.

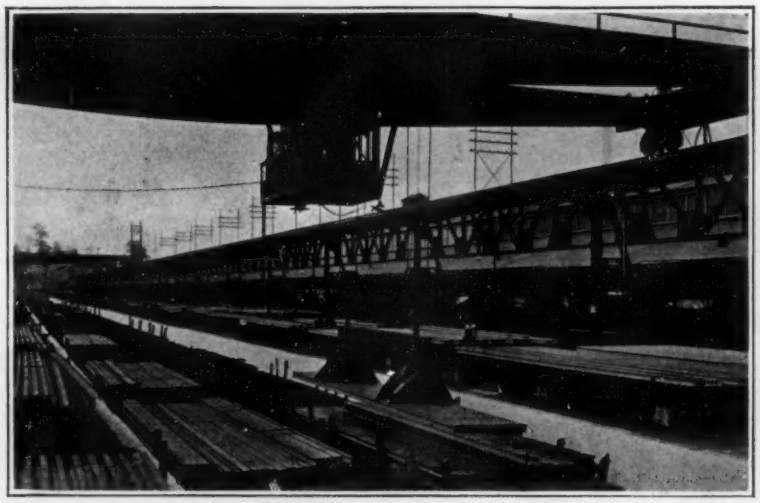
In the early days of railroad history, and up to some 15 or 20 years ago, rails were rolled from Bessemer steel and the railroads called for a steel carrying about 0.40 per cent of carbon. High carbon means hardness and resistance to wear; but it carries with it a brittleness which leads to fracture. As a matter of fact, fractures, as rails grew heavier, began to occur with alarming frequency. An even more prolific cause of breakages was brittleness due to the phosphorus in the Bessemer steel, which was liable to run as high as 0.10 per cent. Phosphorus, however, cannot be eliminated in the converter, and in answer to the demand of the railroads, and in their desire to produce a reliable rail, the manufacturers began to turn to the open-hearth process, in which the phosphorus content can be absolutely controlled. Thereby they were able to get rid of the dangerous brittleness of the Bessemer rail; for, due to the reduction of the phosphorus to as low as 0.05 or less per cent, they were able to increase the carbon content and produce a rail that was at once tough and elastic, and therefore safe, and with sufficient hardness in the head to stand up to its work during a reasonably long life of service.

A modern hundred-pound rail, therefore, will carry about 0.25 per cent of silicon, from 0.60 to 0.75 per cent of carbon, about 0.045 per cent of sulfur and a high content of from 0.70 to 0.90 per cent of manganese, this last element, if it be used with moderation, serving to give a hard steel without any concomitant tendency to brittleness. Manganese also serves to give the very desirable element of toughness to the steel.

We have seen in the preceding chapters that the chemical composition of the steel is determined during its treatment in the converter, the open-hearth furnace or the electric furnace, and that the question of its composition is an all-important one.

Now the cast-steel ingot might be called the raw material of the rail mill, and it will be understood that all the desired chemical constituents are already in the ingot. The rail mills make no change in the chemical composition and they are concerned merely with shaping the ingot into the standard American pattern known as the T-rail, with a heavy square head, a rather slight vertical web and a broad, flat, tapering base. But it should be noted that, although the rolling produces no chemical change, it does produce very marked physical changes, for the cast ingot is crystalline in structure and, therefore, possesses comparatively small tensile and torsional strength, and the rolling serves to elongate the crystals and thereby greatly increases the tensile strength of the steel. Also, the rolling increases the density and toughness of the steel, and in fact gives it a general all-round increase in strength.

For the present brief description of rail rolling we have chosen the plant at Gary, Ind., which contains the largest rail mill in existence. The proportions are enormous, the main building being 1000 feet long, with another building containing the "soaking" pits for both the rail mill and the billet mill, which is 1350 feet long by 84 feet wide. So far as we know, this is the only electrically-driven mill which rolls rails direct from the ingot without reheating. The roll trains are driven by 6600-volt induction motors, three of 6000 h.p. and three of 2000 h.p. The rolls and traveling tables extend continuously down the whole 1000-foot length of this building. At the upper end the white hot ingots enter the first set of rolls and after 18 successive passes emerge at the other end as finished rails. The rolling process is continuous, night and day, and to stand on the observation platform and watch the mighty operations is one of the sensations of our present-day, highly sensational industrial world. In every 24 hours this mill can turn out 4000 tons of finished 100-pound rails.



Loading the finished rails by means of overhead electric crane, which is here shown lifting twenty-one rails at one time

At the Gary mill the ingot molds are carried on four-wheeled cars, four to each car. After the steel metal has cooled to the point of solidification the molds are lifted off by an overhead steel crane, and then each ingot is picked up and lowered into a soaking pit. This is a comparatively small furnace with a cast-iron, silica-brick-lined cover, which is heated by burning gas. Here the ingot remains for an hour and a half, more or less, according to the quality of the steel, and in these pits the workmen will tell you that the ingots "set"—that is to say, they become of uniform temperature throughout, so that there is no soft core of partly solidified metal at the center. The soaking pits at Gary can take four ingots per pit. In them, the temperature of the ingots is raised to the desired point for rolling. When an ingot is ready, the cover is removed, an arm from the overhead crane reaches down and with its steel fingers grips the ingot, lifts it out and sets it on a rolling table, which consists of rotating rolls set one beyond the other in the direction of the first four sets of ingot rolls, in which the four-ton ingot is reduced to a "bloom," 14½ inches by 11½ inches, by 15 feet long. It then moves on to the three-high blooming mills, which consist of three rolls, each about 33 inches in diameter, placed vertically one above the other and journaled at each end in a pair of massive upright standards. The lowest roll rotates counter clockwise, the middle roll clockwise, and the topmost roll counter-clockwise. The vertical space between the rolls is regulated by massive screws set in the top of the housing. With a crash the white-hot bloom sweeps through the rolls on to a large vertically adjustable table. The table rises until it is level with the aperture between the middle and the top roll, the ingot being turned over through 90 degrees by means of levers operated from a distant platform; it stops, reverses its motion, and then comes back with a crash between the middle and upper rolls. It is received on a table which is lowered and sends the mass through for its third pass, the bloom steadily growing smaller in section and increasing proportionately in length. Thus, in less time than it takes to tell it, the bloom has made nine passes and it is now one-quarter of its original section and proportionately longer. Next, it rushes down the mill on rapidly spinning rollers to the shears, which cut off its rough ends, containing impurities and also what there may be of any original "pipe." It is cut to the desired lengths and the pieces pass on to the first of the "roughing" rolls.

Hitherto the rolls have been true cylinders. From now on the successive rolls have deep grooves which, in each successive set of rolls, correspond more and more to the shape of the finished rails. Three passes are made through the first "roughing" rolls, a single pass through the second "roughing" rolls, and another pass through the "dummy" rolls, by which time the rail is recognizable for what it is going to be. Finally, there are four passes through the finishing rolls during which the rail assumes its perfect finished shape. From the last finishing roll the rail, looking for all the world like a huge red snake, comes to rest beside three circular saws, which are set at distances corresponding to the 33-foot length of the rail plus seven inches allowance for contraction during cooling.

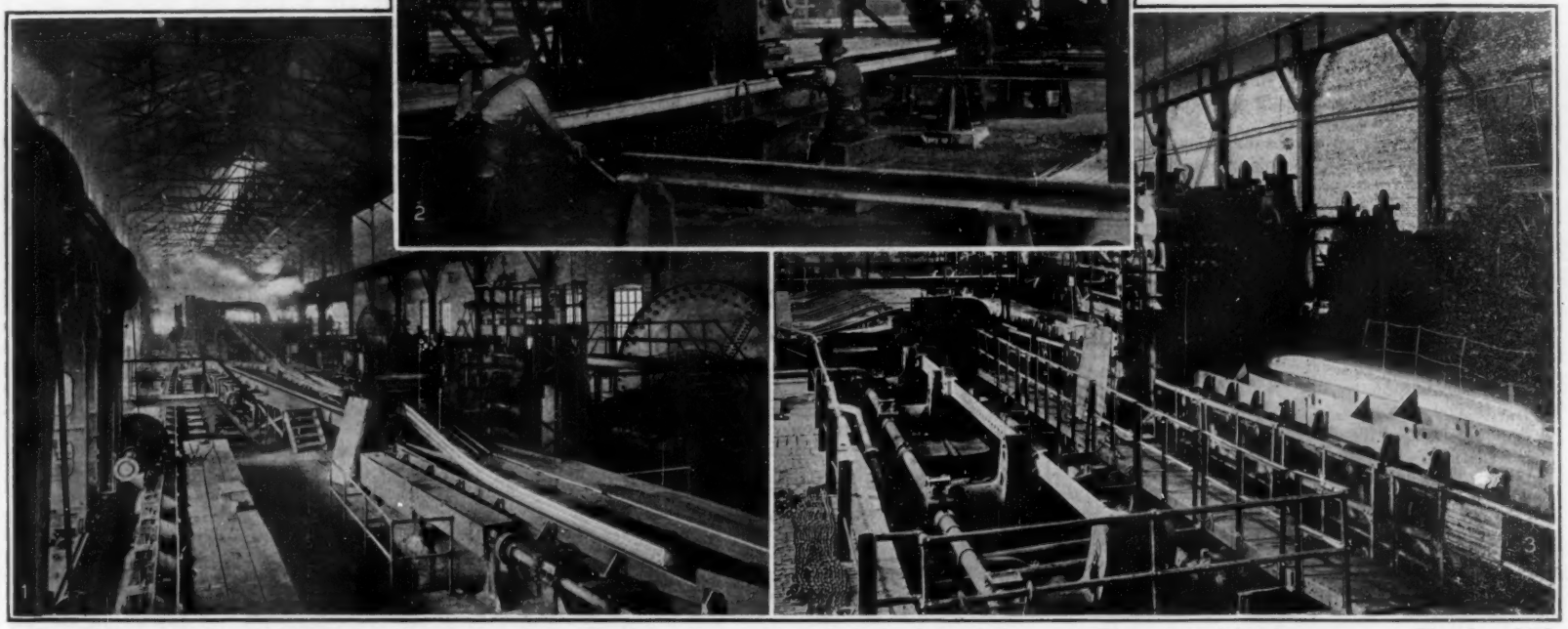
Not only does the heat in the rail affect its length but it throws it out of line longitudinally, and if provision were not made to counteract this it would be badly curved in its length when it cooled down. The latter tendency is counteracted by passing the rail through a cambering machine, which bends it so that it is convex as to its upper face. The rail is then carried down a roller table and drawn laterally on to what is known as the cooling bed, where it cools down and the cambering disappears leaving the rail approximately straight.

Each rail is then conveyed to gag presses where it is cold-straightened. In the gag press the rail is placed upon two supports which are from 40 to 60 inches apart, and any part of the rail that deviates from the straight is laid upon these supports and a plunger comes down centrally between them to do the straightening. A skilled workman determines the amount to which the rail is to be bent, by placing between the plunger head and the rail a flat gagging iron, which is slightly tapered. This straightening is done on all four sides of the rail. After this the rails are finished off by chipping or grinding to remove burrs and the sawn ends are smoothed by filing. Then the rails go to the drilling machine, where three holes are drilled at each end for the insertion of the splice-bolts.

It should be mentioned here that during the rolling of the rails at the Gary shops there are no less than seven separate inspections, after the last of which they are loaded at the stock piles. From stock they are loaded on to the railroad cars by powerful magnets suspended from overhead cranes; weighed; and shipped to the customer.

German Chemists Study Boll Weevil Control

THE German dye cartel is showing great activity in connection with the study of boll weevil control. Some are of the opinion that this indicates that the German chemists think they have made a discovery that can be applied in boll weevil control. Others think the Germans, realizing the commercial importance of any chemical that would prove more effective than calcium arsenate, simply have set themselves to the task. There is no tendency to discount the possibilities in this connection. Chemists responsible for salvarsan, for Bayer 205 and for a long list of other remarkable chemical achievements are thoroughly capable of developing some poison which would be effective in the control of the boll weevil. It is thoroughly recognized that no single chemical development would be in a position to capture a more important financial prize.



1: Finishing end of the 1000-foot rail-rolling mill at Gary, showing rail approximately in its finished shape. 2: The rail-straightening press. 3: The three-high blooming mill. The white mass to the right is the ingot, already reduced, by passing through four sets of ingot rolls, to a bloom fifteen feet long

Left: **No. 2 turret of the U. S. S. "Mississippi," showing the three 14-inch guns. It was in this turret that 48 lives were lost.** *Right:* **The red-hot powder gases, which are light brown in color, show black upon the plate. The white effect is the cold-air blast, which issues from the muzzle after the discharge**

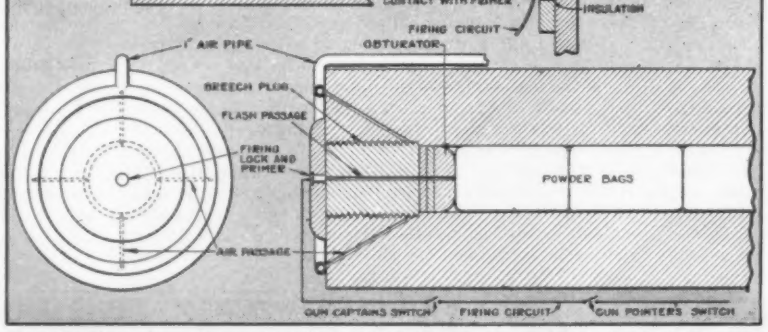
The Battleship "Mississippi" Disaster

The Elaborate Precautions Against Premature Ignition or Explosion of the Ammunition

THE TRAGIC disaster on the battleship "Mississippi," resulting in the loss of 48 lives, carries us back some 20 years or more to similar disasters which occurred on the battleships "Missouri" and "Georgia." These were due to what is known as a "flare-back." A "flare-back" is liable to occur when the breech is opened after a charge has been fired. The slow-burning smokeless powder, in those days as now, was sewn up in silk bags, and after the gun was fired there was always a possibility that a certain amount of unconsumed powder gas remained in the bore, together with some burning fragments of the silk. When the breech is opened the outside air, particularly if the ship is steaming head to wind, is liable to sweep down through the bore, expelling this gas and the burning fragments and driving them back into the turret. Once the unconsumed gas meets and mingles with the oxygen of the air in the turret, they may ignite, and if a new charge of powder ready for the next loading is in the turret, it is liable to be set on fire. This is what occurred in those early disasters, and immediately thereafter special precautions were taken in the design of the magazines, ammunition hoists, and of the turrets themselves, as well as of the firing mechanism of the guns, to eliminate this danger. The new arrangements have proved to be very successful, and the United States Navy has been singularly free, for nearly a quarter of a century, from disasters of this kind.

With a view to reassuring the public as to the safety of our present target and battleship practice methods, we present the accompanying diagrammatic views showing the construction of the barbettes and turrets of such a modern ship as the "Mississippi," and the really very elaborate precautions that have been taken to prevent the very disaster which has recently so unhappily occurred. The matter is undergoing thorough examination by a special Naval Board, and although practically all the eye-witnesses were wiped out, it is believed that sufficient evidence will be gathered to explain just how the disaster occurred.

Of the diagrams at the foot of this page, the one to the left is a vertical, longitudinal section through a barbette and turret; the view to the right is a transverse vertical section through the same; and the center view is a horizontal section through the turret.



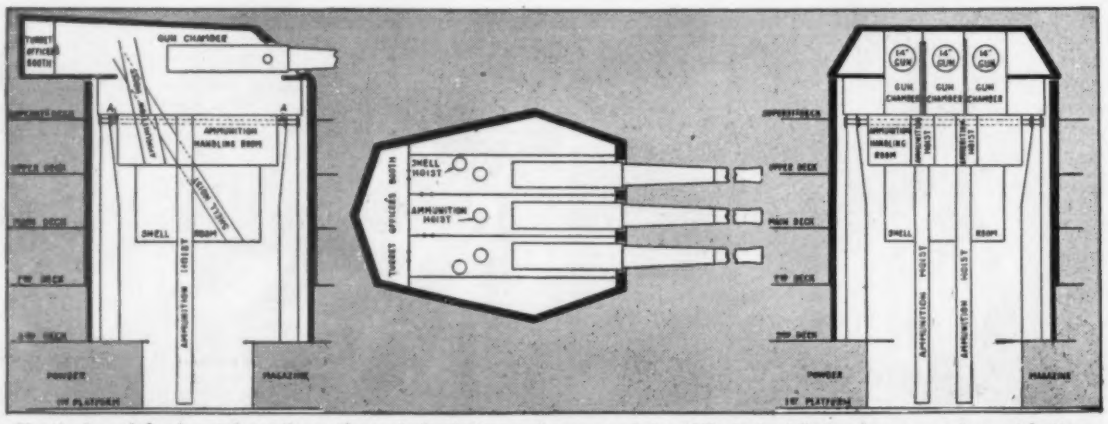
The sketches show (*above*) position of shell, powder and breech-block in gun; (*below*) the air-pipe by which the air-blast is sent through the gun

In the first place it will be noticed that the ammunition (powder and shell) is carried in magazines which are located at the very bottom of the ship, and therefore about 30 feet below the waterline. Above the magazines is built up a circular barbette encased in heavy armor, which is shown by the thick black lines. Immediately within the wall of the barbette, and arranged in a circle, is a series of heavy vertical plate girders or posts, upon the top of which, at the point marked *A* in our left-hand drawing, is a large and massive turntable. Resting upon the turntable is the turret structure. The upper portion of the turret containing the three 14-inch guns is a seven-sided structure whose shape is shown in our center drawing. The turret, like the barbette below, is protected with very heavy armor varying from nine inches at the rear to a maximum of 18 inches at the front port-plate, through which the three guns project. Below the armored portion of the turret it will be seen that there is a circular structure formed in three sections, all being integral with the armored section, with its topmost floor resting upon the turntable at *A*. Below this floor is a section of smaller diameter called the ammunition handling room, and below that is a third section called the shell room. Extending down from the floor of the turret and terminating just above the first platform of the ship are two ammunition hoists. Also, there is an inclined shell hoist leading from the floor of the shell room to the rear of the guns, and an ammunition hoist leading from the ammunition handling room.

The three guns are mounted in a common carriage, and therefore are elevated and depressed together. Their trunnions pivot close to the port-plate of the turret, so as to necessitate as small an opening as possible through the heavy protective armor. Across the after end of the turret is a steel bulkhead which serves to form a "booth," in which is located the turret officer in charge.

The powder is sewn up in cylindrical silk bags and each bag, until it enters the turret, is carried in its own metal container. Both the powder and the shells are stored in racks in their respective magazines below. They are brought out of the magazines on overhead trolleys to the bottom of the ammunition hoists, where they are loaded into ammunition trays and carried up by high-speed elevator gear to the breech of the guns.

In order to increase the rapidity of fire during battle practice, or during an actual engagement, a supply of shells is stored in the shell room and a supply of powder in the ammunition-handling room



Vertical and horizontal sections through barbette and turret of the "Mississippi," showing magazines at bottom of ship, shell and powder hoists, and the structural precautions to safeguard both the crew and the ship

(*Continued on page 223*)

An Advance in Trench-Digging Machinery

THE economical digging of trenches for the sewer and drainage job has long been a problem, the solutions of which many concerns have sought. For years the standard shovel and dragline have been used on ditching and trench work. But here many difficulties are encountered. A shovel must straddle the trench and when mats are laid across the trench and a shovel put to work upon them, the flexibility and mobility of the machine are curtailed. The mats have to be moved as the machine advances, which means lost time and labor. If the walls of the trench are not firm there is always danger of a cave-in that may cause hours of delay and trouble.

Where a wide trench with sloping sides is required, the dragline is satisfactory, but it is next to impossible to secure a square-cut deep trench with this type of machine.

There has now been developed a new machine called a trench pull-shovel, which is a real step in the advance of trench digging machinery. The manufacturers have combined a paramount advantage of the dragline, that of backing away from its work, with the digging ability of the shovel. This machine is a back-action shovel in every sense of the word. It is driven by a gasoline motor, is mounted on crawler treads and is highly mobile. As it backs away from its work, it is always on firm ground, needs no mats and never has to straddle the trench. It is steered and operated by one man without swinging the cab. Its high mobility and power permit of its going anywhere and allow the same flexibility as that given by the dragline.

The pull-shovel begins where the shovel leaves off. It is a well-known fact that the deeper the standard shovel digs, the more power it loses. Thus at depths of greater than four feet, the power is almost lost. Nothing like this is encountered with the pull-shovel. On sewer work this machine digs a square even-sided trench slightly wider than its dipper which comes in sizes of 24, 33, and 42 inches, and with its long reach and full digging power it will dig any depth up to 16 feet and pile quickly and easily to spoil banks with the same ease as the standard shovel. By a change of booms, it can be converted to a dragline in a few hours' time, thus with two booms and the machine, the contractor is equipped to handle practically any kind of drainage or sewer work.

Should the operator require a crane, he can, with a slight change and the dragline boom, have a machine that will handle a one-yard clamshell, orange-peel, hook-block, or pile-driver leads and by changing to still an additional boom, the machine can be converted to a standard shovel. With these attachments, the operator has four machines in one.

The cost of moving from one job to another is greatly reduced by the pull-shovel. It will leave the job, load itself on a standard flat car under its own power, and can be shipped without dismantling. This feature eliminates the usual high cost and lost time of preparing the machine for shipment, by removing cab, boom and caterpillar base, and erecting them at the destination—necessary operations encountered in so many other machines. The pull-shovel is always ready for work on arrival at its destination, with no time lost in getting cleared for action.

New trenching machine that combines the advantages of the standard shovel and the drag-line

A Giant Among Vertical Spillways

THE Deerfield River rises in central Vermont and flows into the Connecticut River at Greenfield, Mass. Lacking abrupt drops, it still has a comparatively steep gradient which results in a total fall of over 2000 feet in a length of 80 miles. At the upper end, for over 50 per cent of its length, the stream flows between steep banks in sparsely settled country, giving an ideal location for water storage. The largest development along the river, known as Davis Bridge, is completed and in operation.

In this section of the country, materials suitable for the construction of earth dams are readily available, and this type was therefore selected. The dam at Davis Bridge is probably the highest earth-filled dam in the world at this time, though we are informed that the United States Reclamation Service has under construction such a dam of greater height.

In building an earth fill, the flow of the river must be by-passed in order that the fill may be made. This was done by driving a diversion tunnel around the dam, through the rock on one side of the site. In the Davis Bridge job, this necessity was cleverly linked up with the construction of the spillway.

The construction of the dam, showing the spillway mouth, and the high hills surrounding the site which made the usual type of spillway out of the question

At the dam site the hills on both sides rise to great heights, preventing the usual course of putting in a spillway at a low divide in the surrounding elevations. Where this method of carrying off the flood waters has been impossible, it has been customary to construct a masonry spillway at one end of the dam; and the topograph has usually been such as to require a spillway channel for conducting the water from the foot of the spillway proper, down the hillside and back to the bed of the river. In this connection every precaution must be taken to protect the earth fill and the hillside itself from wash-out due to overflow.

Such a re-entrant spillway was first considered for the Davis Bridge dam. High-water figures for years back, however, indicated a necessary capacity for the spillway of 27,000 cubic feet per second; and the contour of the ground was such that a hillside spillway of this size involved very formidable problems and high costs, with an element of uncertainty due to the indeterminate character of some of the hydraulic problems of the case. It was therefore decided to examine the possibilities of carrying the flood waters through a vertical shaft into the diversion tunnel previously mentioned, thus eliminating the cost of the hillside channel and gaining permanent use for the tunnel which had already been cut. Hydraulic tests upon a working model having indicated the feasibility of this, the plan was adopted. The intake for the spillway is about 350 feet upstream from the center line of the dam crest. On the side of the river where the spillway is located, rock foundation was found suitable for such an intake. The entrance to the spillway is shaped like an inverted horn, 160 feet in diameter at the mouth and contracting gradually to the same diameter as the tunnel to which it leads—22.5 feet. At low water, more or less of this horn, of course, projects above the surface of the stream. Similar spillways have been used in small dams, but hardly on such a large scale.

The vertical spillway at Davis Bridge dam in action

An objection which might be advanced would rest upon the fear that the spillway would entrain air in such quantity as to affect seriously its water capacity and its general operation. This was perhaps the major question which it was necessary to settle with the model. The original design contemplated carrying the maximum flow of 27,000 second-feet with a seven-foot depth of water on the spillway crest. This crest was to be entirely clear. The final design provides for a crest with 16 bridge piers and requires a depth of water on the crest of eight feet in flood water.

The section of the diversion tunnel which serves as a part of the spillway has a "horse-shoe" cross-section, equivalent in area to a circle 22.5 feet in diameter. It was decided to make the vertical spillway shaft circular in cross-section, and to reduce it to a uniform diameter of 22.5 feet as soon as the water, falling over the spillway lip, could be accelerated to the required velocity; and to connect this cylindrical shaft to the tunnel by a 90-degree bend, a part of which would be circular in cross-section and the remainder would consist of transition from circular to "horse-shoe" shape.

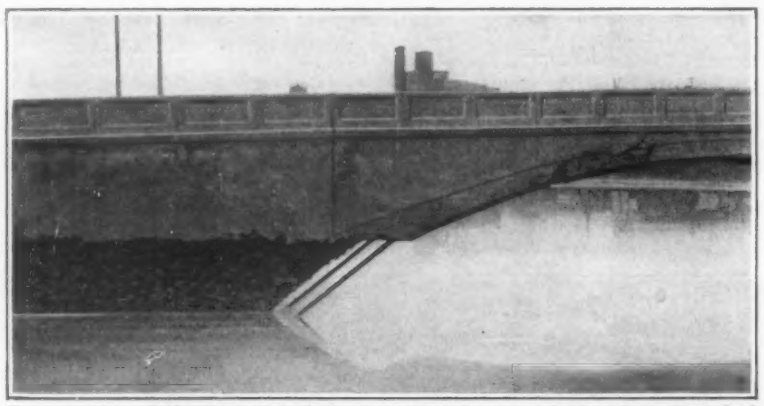
Having fixed the foregoing features of the shaft and its connection to the tunnel, the next step was to design the spillway lip and the converging section. The velocity in the latter section at full capacity being 68 feet per second, it is evident that the water must have a free, frictionless fall of more than 72 feet, in order to attain it, and the time required would be about 2.2 seconds. Inasmuch as the water must have an initial horizontal velocity when it passes the spillway lip, it will take a parabolic course in its free fall. If this free fall should begin at the spillway lip, the initial horizontal velocity with a seven-foot head could not possibly exceed 17.5 feet per second, with the most favorable design of lip; and the discharge per linear foot could not possibly exceed 74 cubic feet per second. At this rate for the total discharge, a circular spillway lip with a radius of 58 feet would be required and the average time for the water to cover the horizontal distance from the lip to the cylindrical shaft would be 300 seconds. The disagreement between the intervals of time required for horizontal and vertical travel of the water shows: first, that the free fall cannot begin at the spillway lip, inasmuch as the jet would have attained its final vertical velocity before it had traveled all the way from the lip to the cylindrical shaft; hence, that lip must be in the nature of a flat crest weir rather than a typical parabolic spillway section of high discharge coefficient. Having arrived at these decisions as to the general features of the design, the determination of the actual details was a matter of "cut and try."

Saving a Rotting Concrete Bridge

How Good Cement Was Injected Under Steam Pressure to Take the Place of the Bad

By Harold P. Brown

EARLY in 1920 one abutment of a large concrete arch bridge at Burlington, New Jersey, was found to be seriously injured by the erosion of ice and tide water. All the lower reinforcing rods and the stirrups placed at the skew-backs were exposed and undermined along the entire width of the bridge and dangerous cracks had developed in the arch ring faces. The damage, however, was considered superficial until the work of repair was begun. It was then found that the entire mass of the abutment concrete between low tide and high tide levels was soft. The stuff could be scraped off to any depth; holes could be poked into it anywhere. The bridge was worthless, but before its final condemnation it was decided to try a novel method of restoration invented by the present author, the originator of the steam-jetted concrete processes that were used.



General view of the damaged abutment, after the outer layer of concrete had been picked off clean

The method was successful in solidifying the softened mass without removal, and a recent examination shows that the work is in perfect condition after four years' service. A description of this new process may be of value in saving other structures. Or it can be used to advantage for strengthening underpinning; for placing sub-foundations without excavation; for checking leakage in dams or canal banks; and in solidifying fills of cinders or other loose materials.

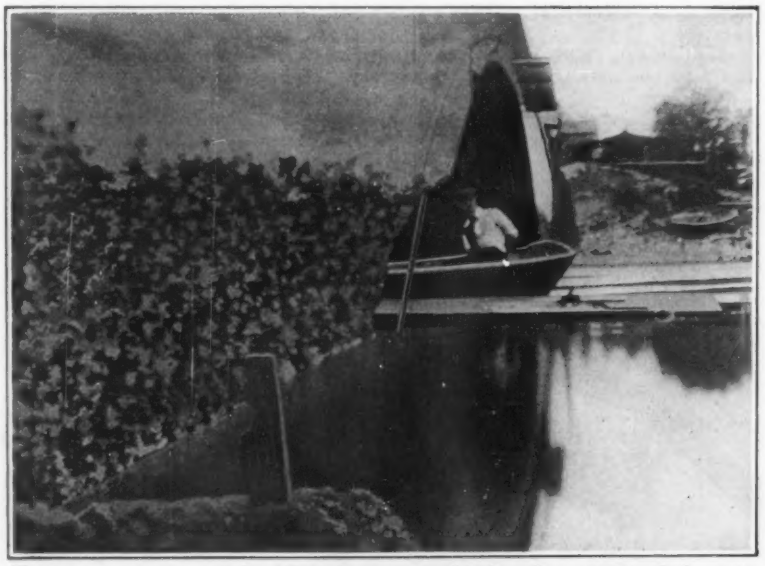
It was decided to remove all the softened concrete in the eroded area; to clean the surface by the Brown method with a jet of super-heated steam and pebbles, and to cover the heated face at once with steam-jetted cement mortar from the concrete atomizer. This hardens almost instantly and is not injured by submersion as the tide rises. To obtain solidity, however, a hard surface must be provided to serve as anvil to receive the impact of the stream of concrete and to act as foundation for the new work.

When the repair work was started, the men were directed to use scrapers to remove all soft material until solid, uninjured concrete was reached. The wet surface was therefore scraped until in some places a depth of over three feet was reached and the upper course of arch reinforcing rods was exposed. The material was still soft. It was then found that deep holes could easily be made anywhere and no solid concrete could be found in the entire northern abutment between high tide and low tide levels. It was evident that the entire weight of the north end of the bridge was carried by the submerged lower ends of the main longitudinal reinforcement of the arches, aided to a slight extent by the compression of the semi-plastic mass between the upper and lower slabs of uninjured solid concrete. The bridge was worthless.

The writer, who was in charge of the repairs, found that large pieces of the softened material dug from the abutment and placed under steam pressure were cleaned of all dirt and impurities. The sand which was left was sharp and the aggregate of good quality and properly distributed. By placing the clean pieces again under steam pressure in a hot cream of cement and fine sand the cement was made to penetrate the soft mass and produced a solid concrete after cooling. The writer believed that by a modification of this process he could remove all salt and dirt from the softened stratum without excavation and at once inject hot cement cream to fill the interstices. He had already, in bitter winter weather, anchored a moving stone wall along a canal bank behind which a fill supported the tracks of the Lackawanna Road; and had checked a sliding cinder fill 650 feet long and 150 high on the Pennsylvania Road by injecting super-heated steam followed by charges of hot grout under pressure. But neither of these jobs was submerged twice a day by dirty salt water. No other plan of saving the bridge was suggested, and he was authorized to try his method, which was as follows:

From a point in the center of the driveway directly over the line of deepest erosion on the base of the arch a vertical hole two and a half inches in diameter was drilled a point just 12 inches above the surface of the erosion. A second parallel hole of similar depth was drilled 12 inches to the east of the first, and a third hole 18 inches to the west. As the tide fell, steam at about 20 pounds pressure, heated to 350 degrees F., was applied to hole No. 1 until it flowed out of hole No. 2 as clean water. This was temporarily plugged and the pressure slightly increased until clean hot water seeped out of hole No. 3 and from the eroded surface underneath. Hot grout was then applied at hole No. 1 until it filled No. 2, which was then permanently plugged, and the process repeated until the cement appeared in hole No. 3 and at the bottom of the arch. It was then evident that the dirt and the salt had been washed out of a cylinder with a diameter of three feet and the interstices filled with new cement. On the following day it was found that this had hardened, in spite of the immediate rising of the tide.

The process was continued day after day until the entire plastic mass of the abutment was solidified. Test holes into the restored concrete drilled at the end of each week showed that it was already harder than the five-year-old concrete above high water. After restoring the entire intermediate mass of the abutment, work on the eroded surfaces was taken up. All unsatisfactory surface concrete was removed and the rust was scraped from the exposed reinforcing rods. Steam was used to jet a load of small pebbles against the surface to take off the salt and slime of the tide water. A concrete with one part cement, three parts sand and two parts fine pebbles was then jetted on to the hot surface by means of the concrete atomizer until the surface approached within one-half inch of the desired level. The pebbles were then left out of the concrete and an amount of diatomaceous earth equal to about 8 per cent the volume of the cement was added to each load. This delayed the set of the concrete and permitted the troweling of the surface.



Close-up appearance of the affected concrete, showing the extent and character of the deterioration

The cracks were chiseled wide open until solid material was reached. Then the concrete carrying the fine pebbles was used to fill them to overflowing. The pebbles served to drive home the cement mortar to the bottom of the crack, binding the surfaces firmly together. Without the use of pebbles it is impossible to fill cracks and crevices with projected mortar, since air pockets in the depressions deflect the particles of sand and cement to the edges of the holes until the surfaces unite over a cavity. In like manner the pebbles drive the mortar behind the reinforcing rods, where cavities are left when only mortar is used.

Of course, when a stream of steam-jetted concrete strikes a wall surface the pebbles and sand bound away and can be used over again. After a thin layer of practically neat cement is deposited the sand also adheres, and when a layer of one-half to three-quarters of an inch has been built up the pebbles imbed themselves and remain in place and their impact forces the mortar into the interstices of the brick, stone or concrete. Steam-jetted concrete has been made to adhere to polished flint, and even to glass.

Many builders believe that concrete is injured by heat because they have tried in winter to heat the materials before and after mixing, in open metal receptacles. This drives the water from the sand and cement in contact with the metal bottom of the mixer and the result is very unsatisfactory. But when the heat is applied by super-heated steam under pressure in a closed tank the effect is surprising. The heat serves to open the pores of the cement particles and the pressure drives the moisture in so thoroughly that no portion is left unhydrated. This in itself increases the efficiency of the cement by 12 to 15 per cent over that of cement hydrated in the ordinary way. Beyond this is the aid which comes from the fact that the hot cement coats the entire surfaces of the sand grains and of the aggregate with a thinner layer than is given when cold cement is used, and that makes the cement still more efficient. And the climax is reached when it is realized that the heat serves to carry the crystallization to a degree far beyond that attained in the ordinary process of setting. The net result is that for a given crushing strength steam-jetted concrete permits a cut of nearly 40 per cent in the amount of cement used.

The Institute of Physics

FROM the annual report of this venerable British body it appears that the demand for highly trained and qualified physicists at present exceeds the supply. The report deals at some length with the new monthly *Journal of Scientific Instruments* which is being produced by the Institute and edited at the National Physical Laboratory. It also refers to the lectures on Physics in Industry which are being delivered under the auspices of the Institute and a second volume of which will shortly be published by the Oxford University Press. It is believed that the publication of these lectures and their circulation among manufacturers will do much to advertise the importance of physics in industry, and to encourage the employment of physicists qualified to understand where and how physical principles and knowledge may be utilized in increasing the efficiency of existing processes, and in the development of new applications.

Taking the Ear-Phones Off the Waiting Radio Man

THIRTEEN years ago, Lewis M. Clement was a radio operator on ship-board. As he stood watch in the radio room and felt the 'phones bite deeper and deeper into his ears, he vowed that some day he would develop a system to call operators by bell. This resolution now bears fruit in the radio calling system which he has recently brought out. The system will find use in those new applications of the radio telephone in which a continuous watch may not be necessary for the public safety, as, for instance, in ship-to-shore telephony.

The new system is an ingenious adaptation to radio of well-known wire telephone apparatus. Briefly, it consists in putting a 135-cycle alternating current into the radio system, transmitting it as other frequencies in the voice range are transmitted, and at the receiving end using it to operate a sensitive relay.

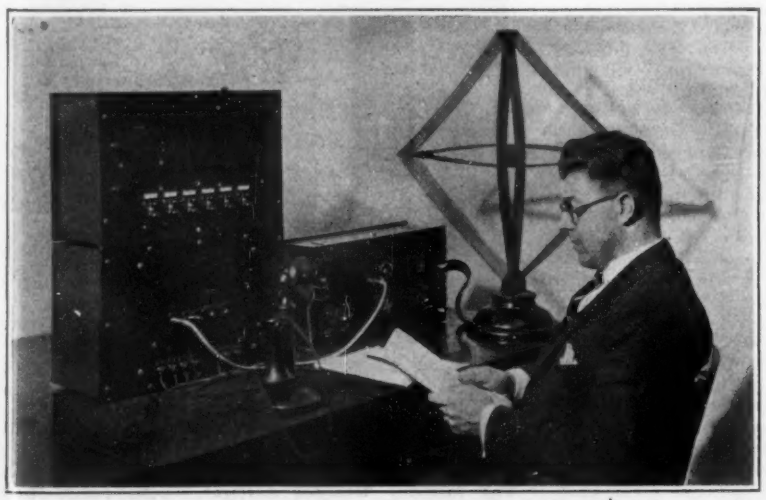
To supply the alternating current, a buzzer operated by direct current is used, and its output is passed through a filter network which suppresses harmonics of the 135-cycle fundamental. Accurate mechanical tuning is essential for both the vibrator at the sending end, and the sensitive relay at the receiving end. So closely can the relay be tuned that a difference of five cycles per second will double the current required to operate it. This insures that static telephone signals, voice currents, etc., will have relatively little effect on it. The way it operates the next relay is a further protection against false signals. The vibrating relay may close its contacts for only 1/5000 of a second at each stroke and all the electrical energy to pull up and hold another relay must be passed while the contacts are closed. Into a relay of workable size energy flows too slowly for enough of it to be stored in the form of magnetism during such a short time. But electrical energy flows rapidly into a condenser, and so the circuit is arranged to charge one-microfarad condenser during the five-thousandth-second interval. During the time that the vibrating relay contacts are open, the condenser discharges slowly through the second relay, and this current is still flowing when the contacts close again to recharge the condenser. Thus a continuous pulsating current flows through the second relay, and operates it to close its contacts. These contacts will in turn operate any electrical device, such as a bell, a signal lamp, or a selecting switch.

The use of standard train dispatching equipment enables the system to be used to call any one or all of a number of stations from a central point. For instance, the control operator, by turning a key marked with the name of a particular station, can send out electrical impulses which will operate selector switches at the receiving stations. Each of these switches is arranged like the combination on a safe, to close its contacts and ring its bell only when a certain combination of impulses is sent out. This apparatus allows as many as 78 stations on one wave length to be signalled separately. In addition, with a further slight modification in apparatus, it is possible to extend the system to signal all or any one out of more than 200 stations.

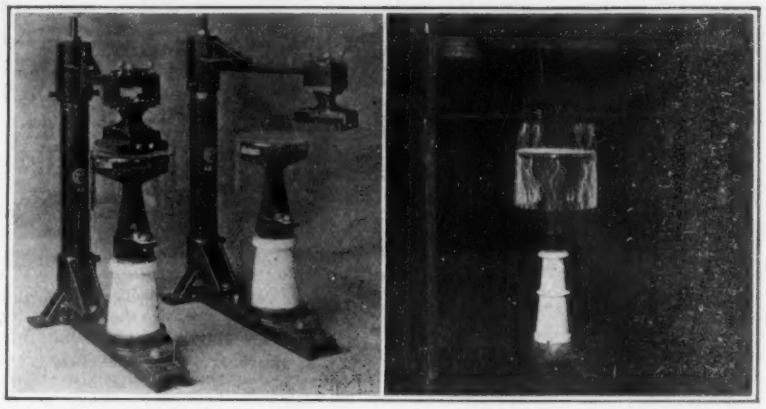
While this signalling system will be of decided importance in many applications of radio telephony and telegraphy, curiously enough it is not based on any startling new discoveries, but rather represents the adoption of certain apparatus that is well known in wire telephony. The 135-cycle input is fed into the audio-frequency input-amplifier at a point appropriate to its energy level. In small transmitters it may be applied directly to the modulator tubes. At the receiving end the output of the detector tube of the regular radio receiver is connected through a special one-stage amplifier to the vibrating relay. Five vacuum tubes must be kept lighted continuously while the station is to be ready for incoming calls, but the current consumption is so small that it is a negligible part of operating costs. Considering the value of an attendant's time, the use of tubes and power in this way makes possible a substantial saving.

As to the effect of interference, tests show that the electrical and mechanical tuning of the receiving circuits and apparatus is so effective that radio telegraph signals similar to those from an I. C. W. or spark transmitter would render speech unintelligible long before they would make the signalling system fail.

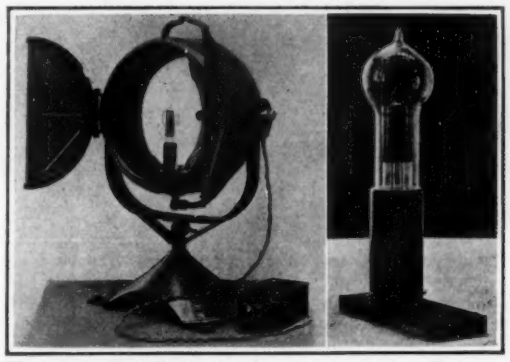
That this system gives no privacy to the conversations is evident. Any station, or for that matter any receiving set within the transmitting range, can overhear what is going on. In many instances—the broadcasting of distress calls, for example—this is a decided advantage rather than a serious disadvantage.



Apparatus for calling ship and other radio stations by bell, so that the operator at the other end need not stand by with ear-phones while waiting a call



Left: **The assembled lightning-arrester unit; by turning the upper electrode, the glass shade lies free and can be easily dismantled.** ***Right:*** **The protective brush-discharge in action**



Thermocouple that reveals the presence, distance and direction of icebergs, shown (*left*) assembled in the focus of the mirror and (*right*) alone, in detail

Glow-Light Protection Against Lightning

BY utilizing the protective qualities of the brush discharge, Dr. Georg I. Meyer of Berlin, has developed an interesting type of lightning arrester for electric power lines, which takes the place of the well-known horn type of arrester. The apparatus, which is shown in the accompanying illustration, automatically effects a brush discharge at the moment when the tension is augmented even by a very small margin over the usual potential. It consists of two electrodes furnished with sharp points or edges, between which is an insulating layer of air as well as a new kind of glass which resists electrical pressure without breakage. Furthermore, the glass will not crack or break when subjected to sudden changes in temperature. The glass is made in the form of a cylinder or shade, as shown. The electrodes are in the form of rakes, consisting of a number of flat iron strips with sharp edges. The top and the bottom electrodes are arranged so that the strips cross at right angles, being separated by air layers and the glass shade.

If a certain voltage, which can be called the "glow frontier," is exceeded by the line, a brush discharge takes place. This discharge is in proportion to the voltage increase, and it fills the air gap and makes it conductive. With a further increase in the voltage the discharge covers the side of the glass shade.

Spotting Icebergs at Long Range

THE menace to navigation from floating icebergs is well known. These huge natural derelicts, in spring and early summer, are occasionally observed as far south as 36 degrees north latitude; and off the Newfoundland banks as many as 350 of them have been observed from a single ship in 24 hours.

Only one-tenth of the mass of a floating berg is visible, the other nine-tenths being submerged. As melting proceeds, the center of gravity shifts; and a berg that looks as solid as Gibraltar is apt suddenly to tip over, with disastrous results to a ship which may have been at an apparently safe distance. Likewise the immersed part is of such indeterminate extent that a ship may ground on it while the pilot is under the impression that he is still in safe water. We all remember the fate of the "Titanic."

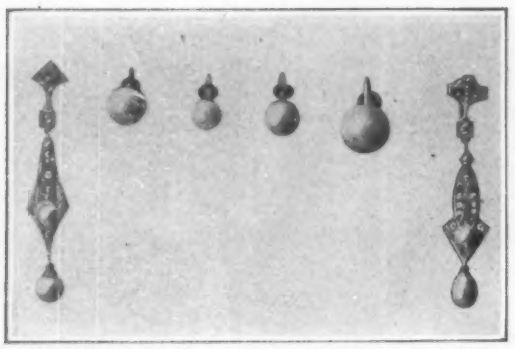
In order to avoid these dangers it is necessary that the approach of the iceberg be known before it becomes visible. The methods heretofore available have not been particularly reliable. Ordinarily they have depended upon the observation of the water temperature. But these observations depend so largely upon currents, as well as upon the proximity of ice masses, that they cannot be relied upon. Likewise, no indication is to be had in this way of the direction of a suspected berg.

To overcome these two objections, the house of Zeiss, in Jena, now offers a "radio-micrometer" for iceberg detection. The instrument consists essentially of two parts: a thermocouple and a spherical mirror. The latter gathers radiant energy and directs this to its own focus, where the thermocouple is located. A galvanometer is likewise attached, to detect the minute differences in radiation.

The thermocouple consists of numerous elements. These are formed of two metals or alloys of different character, soldered together at one end and free at the other. The free ends are connected with the galvanometer. If the joined ends are heated, an electric current flows. There are certain and well known relations between the degree of heating and the electric energy produced by it.

The thermocouple in consequence of its high sensibility must be protected against any draft of air. Therefore it is enclosed in a vacuum tube, from which the air has been exhausted. The mirror has a silvered front so that the radiation has not to go through the glass which would absorb a part of it. The silvering is protected by a coating of colorless lacquer. The reflector with its mount is contained within a metal casing and has at the center an unsilvered clearance about 20 millimeters in diameter affording a free view from the back.

There is temptation to describe the work of this radio-micrometer in the location of icebergs as depending upon the "radiation of cold" by the berg. This, of course, would be inaccurate. The berg, being at a temperature some hundreds of degrees above the absolute zero, is in fact radiating heat—but heat only of such low intensity as to give us, with our limited range of tolerable temperature, a sensation of cold. To the thermocouple, however, the impulse received is actually one of heat of low intensity; and to this impulse it reacts. As it approaches the berg it gives a galvanometer reading in accordance with this fact; and it is directional in its operation. An idea of its sensitivity may be got from the fact that the heat from the funnels of an approaching vessel will affect it at a distance of six miles.



Pearls, set and unset, made from fish scales

Jewelry from Fish Scales

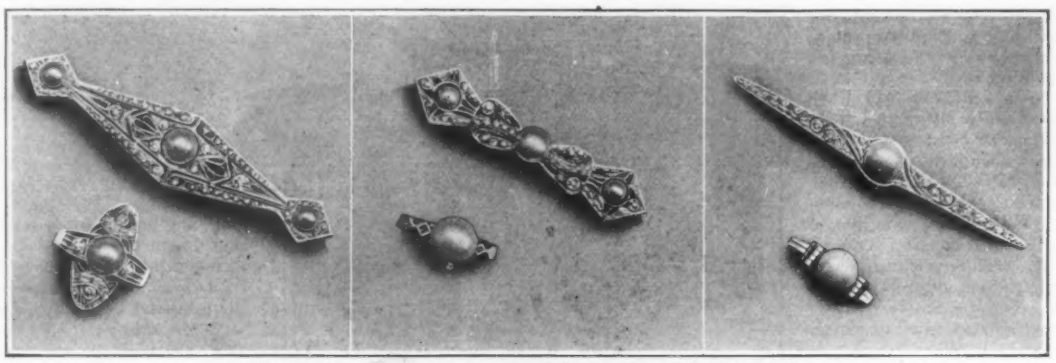
A New American Industry, the Making of Imitation Pearls

By Donald K. Tressler, Ph.D.

Mellon Institute of Industrial Research

THE imitation pearl industry is one of America's novel industries, having been developed during the past ten years. When the World War demoralized the French essence d'Orient industry American chemists immediately worked out commercial methods of preparation of this valuable lustrous lacquer, and soon were manufacturing large quantities of it. The Japanese also soon began making imitation pearls of excellent quality. Today imitation pearls are cheap because of the stiff competition between the American, French and Japanese product. Even the poorest country maiden can afford to wear a string of "indestructible pearls" which can be distinguished from those of her wealthy sisters only by the expert.

Few of the ladies ever dream that the nacre of the pearls is obtained from supposedly useless, foul-smelling fish scales. Milady's indestructible pearls are merely solid opal glass beads coated with a lacquer, the pigment of which is crystalline guanin prepared from the silvery sheen of fish scales.



Artificial-pearl jewelry on a rather more elaborate scale

The lustrous substance of essence d'Orient, with which the imitation pearls are coated, occurs on the scales of most fishes and gives them their characteristic brilliance. When examined under the microscope this nacreous substance is seen to be composed of various sizes of small blade-like crystals. When the epidermis of the scales is scrubbed off under water the lustrous particles are suspended in the liquid. The crude liquor so obtained is filtered through cheesecloth and allowed to settle. After washing the crude essence several times by decantation, strong ammonia is added and the essence is allowed to stand for a considerable time to permit the digestion of the proteinaceous material. The concentrated suspension is pearl essence.

By other improved methods the lustrous crystals are suspended in acetone, amyl acetate or other organic solvents, which are solvents of the nitrocellulose or cellulose acetate lacquer. Pearl essence lacquer possesses many advantages over the aqueous suspension as it may be applied with a brush like any ordinary lacquer.

Various grades are made, distinction being made in freedom from color and in fineness of the crystals. The best pearl essence possesses a brilliant luster, and when slightly agitated gives a unique and most beautiful "whirly effect." The most desirable colors are silvery white and slightly pink. Gray or brown shades of color are undesirable.

The better qualities of pearl essence have uniformly small crystals. The crystals are roughly proportionate to the size of the fish from which they are obtained. Those from the herring and alewife are smaller and make a fine grain essence of higher quality than those obtained from the shad. H. F. Taylor of the United States Bureau of Fisheries has proposed a method of improving the quality of an essence which consists of a mixture of large and small crystals. Taylor's suggestion involves the separation of the large and small crystals by levigation or fractional sedimentation. This process may be carried out by running the essence through a large horizontal glass tube or a large U-tube, regulating the rate of flow so that the larger crystals have time to settle out, but the smaller ones do not. Taylor obtained similar results by sedimentation in bottles. By this process of separation of the larger crystals essence of good quality can be made from shad scales. Perhaps the larger guanin crystals could be ground to make them suitable, but this has not been utilized in commercial practice.

In making the wax-filled beads the essence is allowed to settle, the ammonia is decanted off, and pure gelatin or fish glue is put in, so that a concentrated gelatin solution is made, an antiseptic is added, and if a flesh tint is desired, a very small amount of eosin or safranin is added. While hot this mixture is injected with a fine pipette into the bead, which is being revolved on a toothpick spindle. As the gelatin spreads over the inside of the bead it may be caused to set quickly by brushing a little ether on the outside of the bead. The rapid evaporation of the ether chills the gelatin and sets it. When the beads are dry inside they are filled with wax. Equal parts of Japan wax and paraffin are often used to fill the beads. The cheaper grades of hollow glass beads are blown in molds from tubing. The finer grades are blown individually of a specially prepared soft, colorless glass.

The "indestructible" pearls are made in several different ways. By one process solid "milk" or "opal" glass beads are dipped in ordinary pearl essence containing some gelatin and allowed to dry. A protecting lacquer of pyroxylin or cellulose acetate in a suitable solvent is then applied to make the coating waterproof. These coatings may be applied alternately several times and the finish polished with chamois skin and fine chalk.

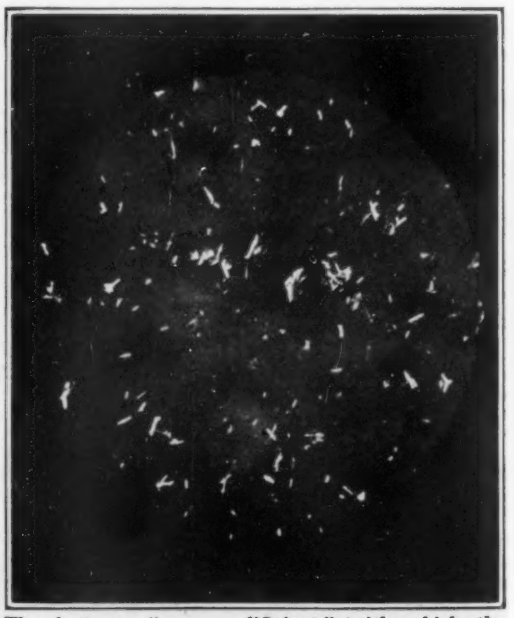
Another method consists of incorporating the lustrous material directly into amyl acetate, in which the pyroxylin may be dissolved directly, making a lacquer that is applied to the bead. When these solvents are used the lacquers may be tinted any desired shade of color by the addition of minute quantities of the appropriate dyes.

The beads for "indestructible" pearls are, as stated, solid and of opal or milk glass. They are made from tubing with the hole of suitable size for the hole through the bead. Appropriate lengths are cut off, the holes are plugged with a refractory material, such as fire clay or graphite, and the pieces are then heated to the softening point in a revolving iron drum partially filled with powdered talc. The drum is revolved until the beads are all shaped, and continued until they are cool.

H. F. Taylor of the United States Bureau of Fisheries has recently devised a very simple method of preparing a pearl lacquer which possesses certain advantages over other methods. According to his process, the fish scales are rubbed in water to remove the valuable lustrous particles. The suspension obtained is drained off, allowed to subside, and the supernatant water, containing any blood, is decanted off. The remaining heavy suspension, containing the lustrous particles of guanin, is treated with a digestion mixture of pepsin, two and a half grams, and glacial acetic acid, 30 cubic centimeters to each liter of fluid, and allowed to act 48 hours. This completely digests and removes all the proteinaceous matter from the guanin crystals. After the digestion the surfaces of the crystals are clean, and they now possess the peculiar property of being more readily wetted by ether and certain other nonaqueous solvents. Advantage is taken of this property to obtain the clean crystals suspended in solvents of the nitrocellulose lacquer. Ether is poured into the digestion mixture and stands as a separate layer on top. Upon gently rocking the container the lustrous crystals leave the water and pass into the ether layer, leaving all dirt, organic matter and the like in the water. Any fatty or waxy substances dissolve in the ether, but these may be removed by allowing the crystals to settle out, decanting the oily ether, and replacing it with clean anhydrous ether. The lustrous crystals are now clean, brilliant, and can be kept indefinitely in the ether or can be easily transferred to ethly or amyl acetate. Nitrocellulose or cellulose acetate may be dissolved in these solvents, thus forming a pearl lacquer, which is applied directly to the bead. Tinted pearls may be prepared by dissolving minute quantities of suitable dyes in the lacquer.

While essence d'Orient may be prepared in unlimited quantities from fish scales, yet it could probably be prepared at a lesser cost in the chemical laboratory from synthetic guanin.

Pearl essence is used in the manufacture of many ornaments other than imitation pearls. Buckles, hatpins, stickpins, watchfobs and many other objects are often ornamented with this, the most beautiful lacquer. It adds a novel luster to transparent celluloid and bakelite articles. If it were a little cheaper it would find many uses in household decoration.



The lustrous "essence d'Orient," with which the imitation pearls are coated

Photographing with the Flash Gun

A NOVEL mode of research by the American Museum of Natural History has been the photographing of various reptiles and amphibians at night with a flash gun. This investigation has been carried out in the neighborhood of New York and in Santo Domingo, where the life-histories of most of the frogs and toads have been determined with an approach to completeness. In this island occur not only the largest tree frog in the world but also the most powerful, if not the largest, lizard in the Americas—the rhinoceros iguana. A museum group illustrating the home life of the latter is being installed. Since it lives in small colonies, digging its burrows through cliffs of fossil corals, it is possible to illustrate the chief features of its biology without overcrowding or detracting from the artistic effect.

Inventions New and Interesting

A Department Devoted to Pioneer Work in the Various Arts and to Patent News

The two-wheeled coaster-pulley for the youngsters

To Check the Reckless Driver

THERE'S a law that after a collision or accident of any description the automobilist must stop and investigate the damage, identify himself, etc. But this law is often more honored in the breach than in the observance. Now comes E. R. Stump, of Seattle, with an invention designed to stop the hit-'em-and-run driver. His device is embodied in the bumper, and would be prescribed equipment for every car. After contact between the bumper and any object whatever the ignition wiring is short-circuited; and before he can proceed the driver must alight, go around in front of his car and reset the bumper switch.

Until he does this he cannot make his engine run; and doing it, officer or anybody else gains the opportunity of questioning him or taking any other appropriate action. Seattle police authorities who tested the device out in service declared that if its use were made compulsory it would be practically impossible for a motorist who strikes a pedestrian to escape unidentified, and the inventor is now attacking the problem of getting it standardized and recognized.

With the bumper in circuit with the ignition, there would be no more "hit-and-run" driving

A New Sensation for the Kiddies

BRINGING the boatswain's chair to land and making a plaything of it, a Cleveland manufacturer has apparently given the kiddies something brand new in the way of a thrill. The "whizzer," as the new play apparatus is termed, is described by its maker as a two-wheeled coaster pulley with a swing seat; and that seems to hit it off very well indeed. The coaster runs on 75 feet of manila rope stretched between two trees or other supports. The speed with which the pulley whizzes down the rope, carrying the suspended seat with it, is determined by the pitch of the rope. After seating himself in the swing, the passenger is hoisted to the higher end of the rope, either by a playmate or, if the pitch is not too great, by his own efforts. Released, he then gets a thrilling ride to the other end of the rope. The hoisting rope passes over a pulley that is separately attached to the tree; one end is made fast to the frame of the running pulley above the passenger's head, the other hangs free to the hand of the hoister. Of this pull-up rope 100 feet are furnished. The manufacturer suggests that, with several persons on this free end, the trip up the incline can be made almost as speedy and exciting as the slide down. Or, if riding without assistance and not able or willing to do the work of pulling himself back, the passenger can place a ladder against the tree, climbing this to get aboard after pulling the whizzer back empty.

Alarm for Bathtub and Ice Box

A DEVICE attached to the edge of the drip-pan under the ice box is so arranged that an alarm sounds before the water reaches the top, thus preventing

Provided with this bell-ringing device the ice box drip-pan tells when it is full

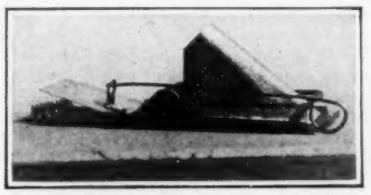
an overflow. The arm connecting the alarm box and the float has several adjustments to regulate the quantity of water to enter the container. As the float, which rests on top of the water, is raised a metal spring, which is kept wound up, causes a hammer to vibrate in the alarm box, thus calling attention to the fact that the water is approaching a level at which the drip-pan must be emptied.

The device may be used on the edge of any type of bathtub to give notice when the necessary quantity of water needed is in the tub. This may be predetermined by adjusting the arm which supports the float on the surface of the water. As the water reaches the desired point in the tub the alarm sounds, indicating that the bath is ready. This does away with the necessity of watching the water run into the tub, in the meantime allowing a person to be engaged in other duties. Another possibility that suggests itself is the use of the alarm to prevent the boiling over of fluids.

For Smoother Motorcycling

MOTORCYCLE enthusiasts are busily discussing a new front fork that minimizes the rough riding which the motorcycle rider has had to undergo previously when traveling over rocky, bumpy roads. Tests over thousands of miles of the roughest country that could be found proved that this new fork represented a most important engineering achievement, adding 100 per cent to riding comfort.

The fork is noiseless in action. The fork-spring absorbs all road shocks and eliminates handlebar vibration. The top spring suspension gives the front wheel the same distance in recoil action as when compressed to its limit. The front springs are adjustable to the weight of the rider, so that a rider weighing 150 pounds will get the same action and flexibility as a rider weighing 250 pounds. The spring design facilitates easy replacing in fork assembly. The fork-crown is heavier and improved in design. The assembly includes a new and improved front mud-guard construction.



Modified mouse-trap for dealing with a plague of sparrows

Trapping Sparrows

GERMANY is suffering, just now, from what a correspondent refers to confidently as a "plague" of sparrows; and means for protecting the small farmer of truck-garden stuff are important. Our illustration shows how the general scheme of operation of a familiar mouse-trap has been borrowed for use in a sparrow-trap. Experience indicates that the evening is the most successful trapping hour, and it is then that the traps are set out.

The Self-Propelled Rail Car

THE past two years have shown a somewhat slow but steadily increasing utilization of the self-propelled rail car. At the present time they are in service not only on many short line roads, but a considerable number of large trunk lines have one or more of them in operation. As a result of continued experience with this type of equipment it is increasingly evident that its field of usefulness is considerably wider than was at first apparent. It also has been found that while the small, light-weight car of the motor-bus type has a definite place in the transportation field, there are other places where a considerably larger car, driven by a more powerful engine, is desirable. The year 1923 added considerably to a better understanding of the various economic and mechanical factors involved in the problem of the self-propelled rail car. Real progress was made in the development of new and larger units. Not only were engines of greater power applied, but new types of control and transmission were built and placed in service. The already difficult problem of transmission is now complicated by a demand for double-end control, and several cars

Details of the new motorcycle fork for which 100 per cent increase in smooth riding is claimed

recently built have been designed for such operation. Of the several transmission methods employed, mechanical, electro-pneumatic and hydraulic, the latter at present appears to offer the largest possibilities.

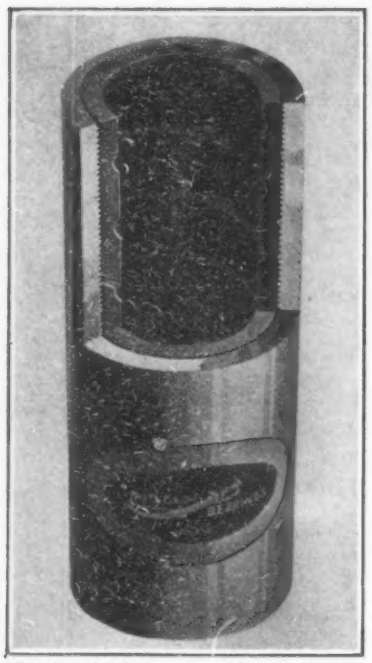
A Mud-Hook for the Mired Motorist

A MUDDIED shoe and trouser leg caused Walter Rice, of Williamsport, Pa., to invent a "mud-hook" for automobiles. The invention has been proved in several severe tests, and a patent has been applied for. It is composed of heavy rubber, and all its parts are vulcanized together. The base of the device is like the outside shoe of an automobile tire, and on it are vulcanized two rubber cleats. Through the rubber shoe a strong strap is run, and on the strap is a buckle by which the device is fastened to the motor car wheel.

Mr. Rice was motoring over a soft country road not long ago when his car stuck in the mud—mud so deep that it lapped over the top of the gasoline tank. Mr. Rice tried to jump from the car to firm ground, but one foot went into the slime. Then and there he vowed to invent some device to rescue other motorists in a similar fix. The result was the "mud-hook."

The other day Mr. Rice went to the same bad spot and found the mud just

The mud-hook for mired motors, shown in place on the wheel and (insert) dismounted, for examination in greater detail



Sectional view of rubber-surfaced bearing

as thick. He ran his car into the mire, attached a "mud-hook" to each rear wheel, and fairly jumped to firm ground. Primarily the "mud-hooks" are for spoke wheels, but they may be attached to disk wheels after thin slots—wide enough to admit entrance of the strap—have been drilled through the metal of the wheels.

Rubber Bearing Takes the Place of Babbitt

BABBITT and bronze have held undisputed power so long as surfacing material for bearings that it is hard to imagine anything taking their places. It becomes much easier, however, when one considers that rubber properly compounded and vulcanized will stand abrasive tests better than bronze or babbitt, or even steel. In a recent test in the Bureau of Standards at Washington a piece of rubber cut from the tread of an automobile tire stood up under the abrasion eight times better than iron.

Rubber-surfaced bearings for engines, pumps, propeller shafts, etc., are a reality. Though they are a comparatively recent engineering achievement, the results secured from tests are most remarkable. One such test was in a centrifugal sand pump which handled 10,450 tons of coarse sand in 693 hours. At the expiration of this time the bearings and shaft were found to be in perfect condition. This same pump with either babbitt or bronze bearings had not been able to run longer than 125 hours without overhauling and bearing replacement.

The principle involved in the construction of the rubber-surfaced bearing is one of automatic lubrication. At present these bearings must be installed in service where they are exposed to water or moisture. This forms its own lubrication for the bearing, because the rotation of the shaft forces water over the surface of the bearing. Water-lubricated rubber has a lower coefficient of friction than an oiled babbitted surface. As a result there is less friction and wear in the rubber bearing, elaborate oiling systems for inaccessible pumps are done away with and, because of the texture of the rubber, scoring or wear on shafts from gritty particles is overcome.

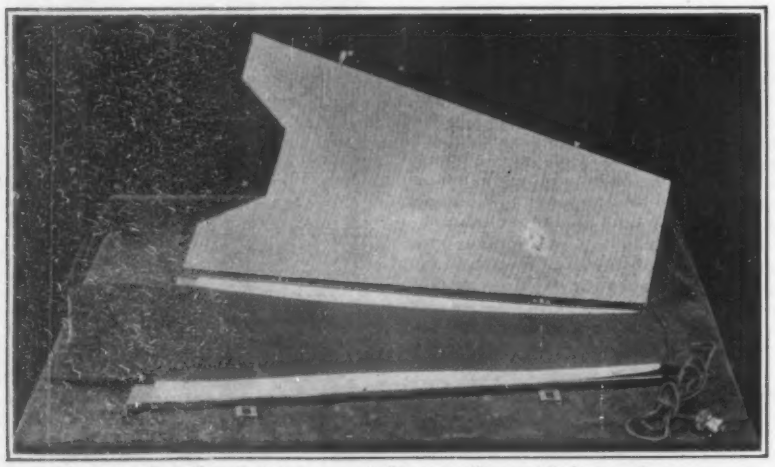
The rubber bearing has become a boon to ship owners for use both in bilge pumps and as stern tube bearings or outboard strut bearings. On tests it has actually eliminated the troublesome and destructive propeller-shaft vibration. The resilience of the rubber bearing also compensates for any misalinement of shaft, acting as a sort of shock absorber and preventing "slapping" or excessive throbbing of the screw.

The Electric Valet

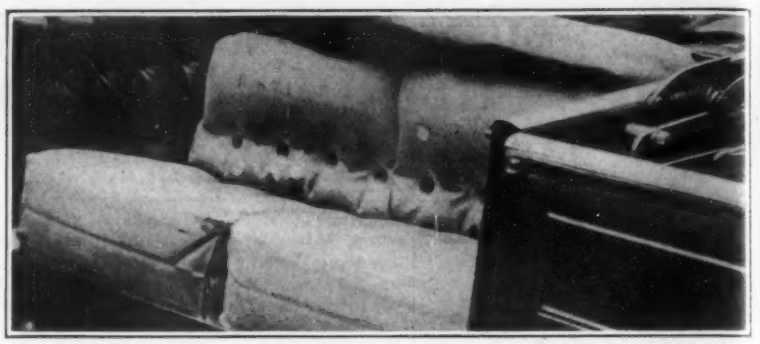
PRESS your trousers at home and save money. Or if you don't have to save money, then send them out and wait for them while you coax the tailor via telephone to get a move on. It is also admitted that a few favorably situated individuals have wives that can be inveigled into pressing their trousers for them; but such men, according to at least one woman, do not deserve to have wives at all. Perhaps you live in a boarding-house and have found that the wise landlord keeps low-amperage fuses on all the electric lights in order to beat you when you try to "roll your own" with an electric iron while he pays for the ampere hours. The only remaining solution of the problem is to send for the tailor's boy and go to bed until his always-later-than-promised return permits you to cross the hallway without the classic barrel.

The electric valet's mission in life is to press trousers. It also condescends to the pressing of wrinkled neckties, but it does not claim to operate on coats. It will press your "trou" without a struggle while you shave, if you shave with a straight razor; or while you shave, wash, comb your hair and attend to the furnace if you prefer a safety. And it uses only two cents' worth of current in the doing, according to its manufacturers.

The device consists of two sheet-metal tapered shapes covered with cloth, and a partition or pad that is placed between the two trousers legs. This pad contains the electric resistance or heating coils that do the desired work. Its cover of cloth is designed to be moistened with a cloth dipped in water. After the pad has been put in place and the second "trouser" of the trousers placed carefully over it, the metal top of the valet is tightly clamped and the current is turned on. About twenty minutes of heat does the trick. You go forth to business ready to make a shining impression on the boss, leaving your fellow employees to wonder why on earth you, and not they, are given preferment when it comes to making promotions.



Substituting the electric servant for wrestling with heavy flatirons



Inset pillars of rubber fabric tie together the sides of this air cushion for the automobile

A New Instantaneous Gas Water-Heater

THERE are three classes of water-heaters—the manual, the automatic storage and the instantaneous. The manual must be lighted each time hot water is wanted, and one must remember to extinguish it. Failure to do this has caused serious explosions due to steam pressure. The second class, known as the automatic storage heater, lights and extinguishes itself automatically and keeps a constant volume of heated water in storage in a tank or boiler at all times. This is highly convenient, but it is expensive. Such a heated tank is in effect as well as in fact a hot-water radiator. As it is constantly cooling down, the automatic device must from time to time turn on the gas to reheat it. In winter this heat is, of course, generally valuable in heating the house, although in most places the cost of this sort of "heating" is high, for in most places gas, in comparison with other forms of fuel, is high. In warmer months this heat is wasted; in fact, in the hot months it is highly undesirable. If it is released in the kitchen that room is kept at a "roasting" temperature. But the true instantaneous heater, which is also automatic in operation, lights the gas whenever a hot-water faucet is opened and turns off the gas when it is closed. The change of water pressure is the means whereby this is effected. The water runs through a coil and is heated as fast as wanted. None is stored.

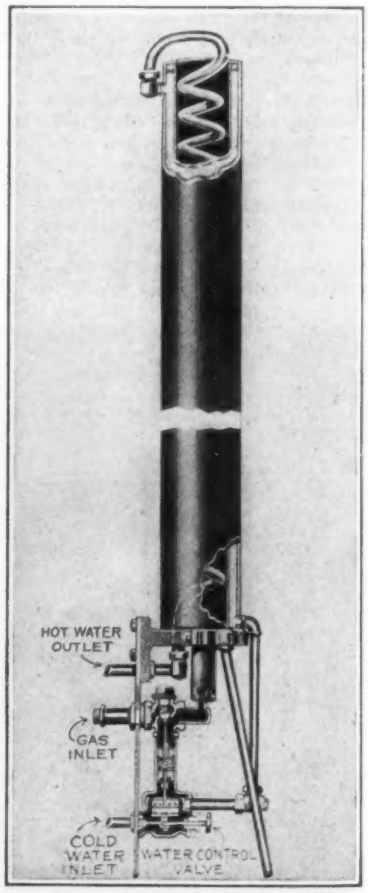
The heater illustrated is of the full instantaneous type. In addition to the coil which is common to all heaters of this class it has a double-shell casing which is filled with water. The idea back of this, according to the manufacturers, a Norwalk, Connecticut, firm, is that water passing between the cylindrical shells furnishes a most practical heat insulator in that it absorbs the surplus heat and loses its initial chill before entering the copper heating coil. In other words, the water first circulates in the shell, then in the coil. In the former it is preheated by means of heat that would otherwise escape from the neighborhood of the coil.

Riding Twice on Air

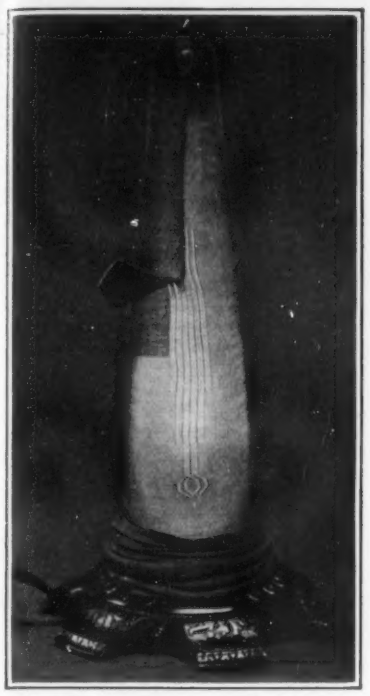
WHEN you ride over pneumatic tires you are riding on air. The improvement over the springless covered wagon method of travel is immense. Now a Manchester, England, manufacturer has "gone this one better" and provided pneumatic cushions in addition to the pneumatic tires. If the tires absorb nine-tenths of the vibration, one-tenth is left. And if the air cushions absorb nine-tenths of this residuum, only one-hundredth of the original is left. There is, however, nothing very original or new about the air cushion as used in a motor car. But there is something new about the kind illustrated—the pillars.

Anyone who has used an air mattress knows how they give you the feeling of skidding and slewing around in space. The mattress is, of course, never completely inflated. If it were, it would cease to be an air mattress, in a sense, for the chief value of this invention lies in the fact that when a little less than fully inflated it permits the user to sink down into it, thereby distributing his weight over a large area of support. But if you were to sit on such a loose-topped air cushion in a moving car you would do an automatic shimmy.

The cushions shown have a number of pillars or columns of fabric built into them in such a manner that the top side and the bottom side are attached in a flexible manner. These prevent the great sidewise displacement of the contained air which is mentioned above. They are equipped with valves which permit quick inflation.



Water in the outer casing of this heater is preheated before entering the coil, resulting in more efficient operation



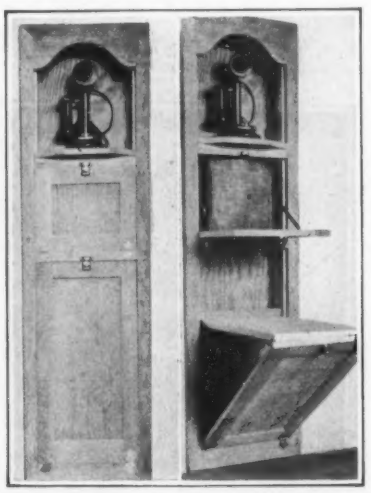
Electric lamp of novel shape to aid in the display of hosiery

A Novel Fitment for the Stocking Salesman

TRADITION demands that miladi, when she buys hose, shall run her hand and forearm into the stocking, stretching the garment over the rack thus provided, for the purpose of verifying its structural integrity—which is another way of saying that until she has looked it over she isn't sure that the stocking is free from runs and similar flaws. But the shopkeeper isn't particularly pleased by this technique of examination, since it is apt to result in damage or soiling. So there is now offered a mechanical arm for the purpose, and one which possesses a marked additional advantage. It is built in the form of an extremely long electric light tube, and the stocking goes right on it, over the light. One then doesn't have to hold it up against daylight for examination—the light shines right through the stocking and greatly facilitates the work of the inspecting eye.

Getting the Telephone Out of the Way

A LOS ANGELES inventor of fixtures for homes has devised a telephone desk-and-stand combination that gives the user fullest convenience, yet that does not intrude on space of the room or hall when not in use. This fixture can be placed between a pair of the wall studs as it is but 13¾ inches wide, 4 feet 9¼ inches high, and 4⅛ inches deep, due to the collapsible feature of the device. The telephone instrument rests in a shallow alcove on a shelf. Just below a flap drops down to present the telephone directory and to serve, if desired, as a writing desk, while the lowest feature of the device is the larger flap that presents a seat.



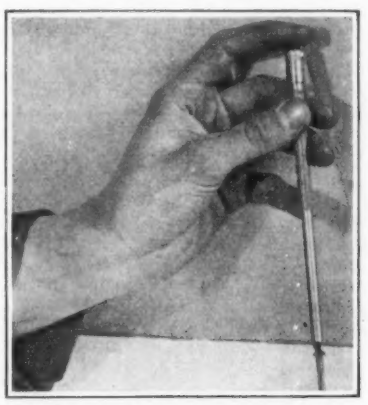
A desk-closet for the wall telephone that occupies no space when out of use

A Handy Bookmark

SOMETHING rather neat in the way of a bookmark comes to the attention of the editorial eye, and is illustrated herewith. It consists of two bent-wire members, joined by a flat bit of metal, as shown in the picture. The smaller wire is in the form of a closed clip, and goes over the cloth back cover of the volume in which the marker is to be used, the metal backbone of the device lying flat against the inner surface of the cover. The longer wire is a free-end clip, and slips over the top of the page which it is desired to mark. When the book is closed on this there is no slightest tendency for the marker to spring off. When not actually in operation the page clip lies idle in the back of the volume, together with the metal anchor-plate; it is then completely out of the reader's way.

The One-Handed Screwdriver

A BOSTON manufacturer has just put on the market a very ingenious screwdriver that will readily commend itself to many. Aside from performing all the usual functions of such a tool it will hold any screw by its slot with a firm grip, thereby adapting itself particularly to machines composed of small parts, such as radio sets, typewriters, sewing and washing machines, lawn mowers, etc.



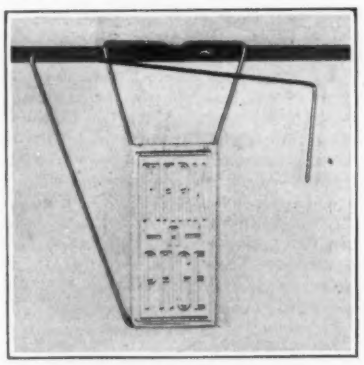
The screwdriver that doesn't need a hand to hold the screw

The tool consists of a hollow shaft engaging a screwdriver bit at one end. A rod down the center is connected to two pieces of spring steel which, when extended, cover over the screwdriver bit and pass beyond to engage the slot of the screw. When pressure on this rod is released the steel springs automatically spread out and firmly hold the screw. This invention makes it easy to place and start screws in difficult places where the ordinary screwdriver would be useless. It is non-magnetic and work equally well with screws of any material.

A Periscope for the Woodsman

NATURALISTS and hunters especially are interested in the indirect vision telescope, a decidedly new type of field glass equipment. The instrument permits sight around corners, and it is therefore possible for the observer to conceal himself completely. The use of optical prisms in connection with the lens system means that the objective lenses are placed far out from the eyepiece, so that a person can see around a tree or over the top of a rock or bush. The distance from eyepiece to objective is 14 inches.

It is possible to use the telescope in dimly-lighted woods, so large is the objective. The magnification is 10 diameters, and hunters are able to identify definitely game at long range. Naturalists find the indirect vision telescope of particular advantage in the study of birds and animals. The instrument has an adjustable tripod, so that continued observations can be made without the necessity of holding the glass. A wooden carrying case, for telescope and tripod, is also furnished. The mounting is such that the projecting objective may be swung out horizontally, vertically, or at any intermediate angle.



The bookmark that is never lost and never in the way

A New Product in Petroleum Refining

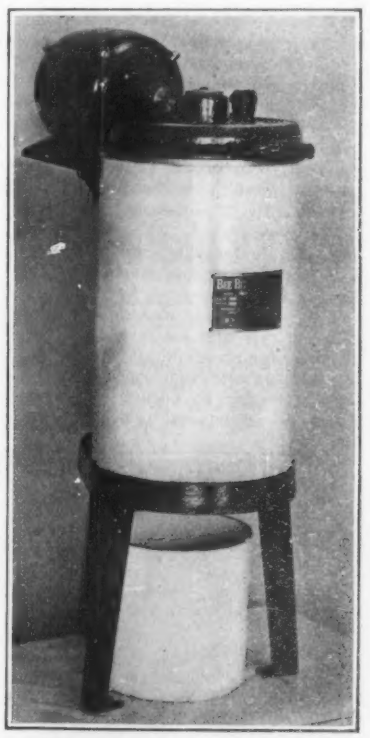
A NEW silica product has recently come into prominence through its use on what now promises to be a large scale in the refining of petroleum. This is an amorphous silica produced by treating silicate of soda (water-glass) with sulfuric acid and subsequently dehydrating the silica hydro-gel obtained. After dehydrating, the material is crushed to 100 to 250 mesh, depending on the purposed application. This product, which is called silica gel, has the property of having exceedingly large interstitial surfaces for a given volume. Particles of the silica, within the grains, are so small that even an ultra-microscope cannot make them visible. They are supposed to be spherical in shape and the mathematical calculations on this basis show that a cubic inch of the material will have more than 5000 square feet of interstitial surface. The spaces between the spherulites act as capillary passages. Any basic industry that has in its operation the problem of separating two liquids or vapors can use, and now is beginning to use, silica gel for that purpose. Silica gel acts as a catalytic agent—that is, a substance which, while assisting a given chemical reaction, does not undergo a change itself. It has the property of adsorption (adhesion) in a marked degree, even greater than amorphous carbon, and due to its high chemical resistency it can be used in a number of processes where carbon could not be employed. The petroleum industry is using more and more of silica gel, both in gasoline adsorption plants and in the refining of petroleum products instead of acid treatment. Silica gel retains all the unsaturated hydrocarbons and the sulfuric compounds. Silica gel is made from water-glass, which in turn is derived from sand. The standard method of manufacturing water-glass is by fusing fine sand with soda ash at rather high temperatures, up to 3000 degrees F., followed by crushing, agitation in water, and sedimentation.

Nature-lover's telescope that gives vision around a corner

Putting the Butcher in the Beef-Fat Business

BEEF fat is far superior to butter for cooking, and it is used almost exclusively in the manufacture of French pastry. The butchers, however, through whose hands it first passes, have not been able to take full advantage of its potential value; instead of being able to sell it for something like 20 cents per pound to the private user, they have been disposing of it, along with other refuse, to the soap-maker, who has been paying them a flat rate of something like five cents a pound for it. A machine is now offered with which the butcher may recover the difference between these values; and its possible value to the business as a whole is indicated by the statement that its general use in New York would effect a saving of $75,000 per day.

There is an electrical heater in the base of the device which extracts the oil from the connective tissue. The latter is still valuable to the soap-maker. The oil is got out at a temperature so low as to avoid all objectionable odor. The material recovered is snow-white in color, and suggests oleomargarine in general appearance. The total cost of operation is stated by the manufacturer of



Machine to enable the butcher to render his beef fat

Protecting the glasses of a swimmer who can't see without them

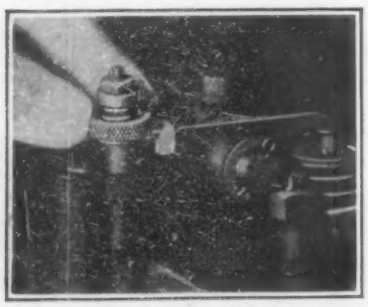
the machine to be less than one-third of a cent per pound: and it will handle from 15 to 30 pounds per hour, according to the hashing of the raw material.

An Experimental Road

A ROAD of precast reinforced concrete slabs has been constructed as an experiment by the California Highway Commission in order to study methods and cost as well as behavior in service. The pavement was made 18 feet wide and 6 inches thick and about one mile was constructed. Most of the slabs laid are 9 by 9 feet in size, but two short stretches are of 6 by 9 and 3 by 9 slabs. The slabs are handled by means of lifting chains engaging in holes cast in the slab. Various types of reinforcing were used. The slabs cost more than the cast-in-place concrete because they must be reinforced, because of extra formwork, because they require two subgrades, one in the casting yard and one in the road, and because they required a sand cushion and elastic joints. These items increase the cost about ten dollars per cubic yard. The experimental road is to be subjected to a traffic largely consisting of heavy loads.

For Ready Valve Adjustment

WITH the device illustrated the automobile owner can adjust his own valves and keep the clearance perfect. Each notch on the knurled dial represents a thousandth of an inch, and by turning this with thumb and finger the proper clearance (usually eight thousandths) can be instantly made and constantly maintained as the valves gradually wear into their seats. In this way is entirely eliminated the rattle of loose valve tappets. The adjuster is permanently installed on the car, one for each valve; and it is guaranteed to last the life of the machine itself. They are sold in sets of eight and twelve, for four-cylinder cars and for sixes; or two sets of eight, for an eight. Their permanent location at the seat of valve trouble makes it easy to adjust the clearance whenever adjustment is needed.



A permanent installation that plays the part of valve-adjuster

A Cap for the Spectacled Swimmer

FOR use by swimmers who wear glasses and to permit a diver to see objects under water and at the same time keep water out of the eyes, nose and ears, an elastic rubber bathing cap with goggles, nose and ear coverings has been invented by 18-year-old A. G. Johnson, Colorado Building, Washington, D. C. The cap is so constructed that while it prevents the entrance of water, it allows the wearer to breathe through the mouth and to talk without removing the rubber cap.

Caustic Embrittlement

THAT nascent hydrogen will penetrate and cause embrittlement of steel plate has long been known and acknowledged, but the conditions under which this may take place have been a matter of contention for some time. A recent investigation, as given in detail in *Power* (59:16, 3 pp., ill.) shows that the free hydrogen attacks the oxides and sulfides of the impurities in the steel, producing voids which increase the brittleness of the material and, by the formation of steam or water pockets, augment the existing stresses and produce cracks. Various concentrations were used in the investigation, many of which were higher than generally used in treating water, although some of them were comparable with the concentrations found within the boiler in the ordinary course of mechanical engineering practice.

No More Boiling Over

THIS curious little device, with no name of maker on it, drifted into the office and was tested with satisfactory results in our own kitchen. It is just a nickel-plated stamping with a small hole. Put in anything which is being boiled (like peas), it will prevent any boiling over. It must be turned down the reverse of our picture to function properly, for if placed with the edge turned up it will do the exact reverse of what it is intended to do, as we found to our sorrow.

Keeping the unwatched pot from boiling over

Artificial Silk

OF the four processes for the manufacture of artificial silk in use in the United States—the Chardonnet or nitrocellulose, the Pauly or cuprammonium, the Cross and Bevan or viscose, and the cellulose-acetate—the viscose process has completely outdistanced the others in production and the cuprammonium process has met with the greatest reverses. Artificial silk is not an imitation of natural silk, as is commonly supposed. It is a distinctly new fiber with characteristic properties. The effects that can be produced with artificial silk cannot be made with any other fiber. It is a chemical engineering product that is here to stay.—*Chem. and Met. Eng.*, 30:19, 4 pp. ill.

Chemical Silver-Cleaning

THERE is nothing specially new in this device, but possibly some of our readers may still be using old-fashioned silver polishes which incur much drudgery. Under the old method the tarnish in crevices is not removed and the paste and powder is packed in engravings and embossings. In the new way fill any utensil of suitable size with hot water. Then dissolve to each gallon of water one-half cup of table salt and one tablespoonful of baking soda (bi-carb. of soda). Place the silver-cleaner, wires up, in this solution. The tarnished silver is then placed upon the wires. In a few minutes the tarnish is all removed. And remaining stains and discolorations are so softened by the action of the cleaner that it is easy to remove them

Cleaning the silver in a chemical bath, with the aid of a wire tray

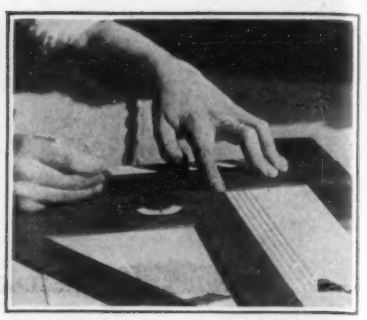
by the use of a wet brush dipped in baking soda. When the silver is taken out of the solution it should be well rinsed in cold water and wiped dry with a soft cloth. Oxidation on oxidized silver is nothing but a tarnish ornamentally applied; for that reason oxidized silver should be left on the cleaner only long enough to remove the extra tarnish. If it is left on the wires too long all the oxidation will be removed.

Iodine as Fertilizer

RESEARCH has recently been carried out which has shown that iodine may play an important role in soil fertilization. As with humans, where iodine has been shown to be an essential to health, only minute amounts are advisable to produce good results; in fact, poisoning may be brought about as easily in plants as in humans. Experimentation has shown that the application of about one pound of iodine, as potassium iodide, per acre resulted in an increase of yield amounting to about one and a half tons of sugar beet per crop. Sea salt for human food and Chilean nitrate for plant food are carefully purified of iodine before being put on the market. It has been suggested that it may be a wise plan to dose the community with a minute amount of iodine added to salt or domestic water used for human consumption, as is being done in Austria. Some engineers believe that inclusion of the minute amount of iodine needed to stimulate plant growth could be made to all commercial nitrate from Chile, thereby enhancing the product for fertilizer purposes at a negligible cost to the producers —*Chem. and Met. Eng.*

Doing the Draftsman's Measuring for Him

ONE of the petty delays that makes drafting a long-winded business is the necessity for constant shifting of the guide—T-square, triangle, etc.—from one position to another; with the necessity for using a measuring tool of some sort to determine accurately the new position. This, in turn, demands that the draftsman lay down his pen, and every workman knows that putting down and taking up his tools is a time-consuming operation, if he has much of it to do in the course of his day's work.

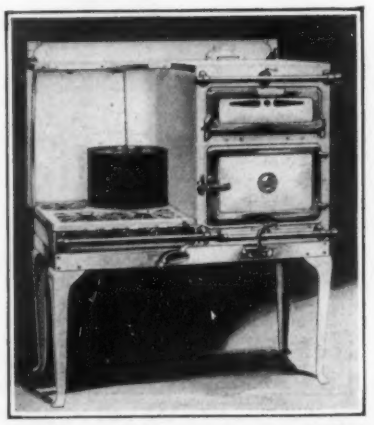


Mechanical measuring for the mechanical draftsman

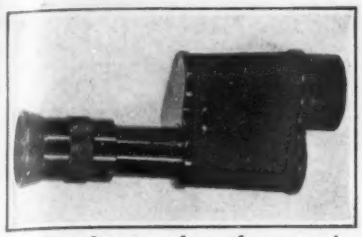
A little device is now offered that does this measuring automatically. It consists of a wheel, mounted inside the ruler, triangle, etc., with its circumference tangent to the working edge of the latter tool. As the triangle, let us say for definiteness, is slid along its own guide this wheel rotates; and it carries around its edge a scale. By watching the dial go around one sees just how far the triangle has been moved. With a little practice shifting to the position of the next line becomes a very rapid process.

A New Version of the Fireless Cooker

IF you don't believe that running a cook-stove is a "man's job" ask the woman that owns one. It requires almost constant watching, and this is the case even when gas is used. Gas has a way of getting down and out when the cook is busy peeling the potatoes. One way to get around a large amount of this drudgery is to buy a fireless cooker. But this entails moving the pots from the fire to the cooker, not to speak of the bother of paying for and keeping clean another cooking unit. The thermodyne provides a way to get around this situation. It is simply a dome-shaped hood, heavily insulated against the escape of heat, which is suspended by a chain over the top of the range and is easily operated by a convenient lever. It utilizes the retained-heat principle for cooking vegetables, stews, cereals, pot roasts, soups and similar foods. All you have to do, according to the claim of the Shelbyville, Indiana, manufacturers of this gas range, is light the gas under the utensil containing the food, lower the dome within two inches of the top, bring the food to a boil, keep it boiling a few minutes, then shut off the gas and lower the dome. The heat is now prevented from escaping. The food will cook on for hours on retained heat.



Making a fireless cooker out of the ordinary gas range



A glass for use where the range is too great for the microscope and too short for the telescope

An Optical Compromise

USERS of optical instruments often need a glass that can be used where neither the magnifier nor telescope serve the purpose. If an object is too far away the magnifier or reading glass will not do; if the object is not far enough away the telescope is of too long range. The problem has been solved by the introduction of an instrument with which objects from 30 inches to 30 feet away can be brought into sharp focus. The "telemagnifier," as it is called, was developed in answer to the request of a prominent naturalist who was studying the habits of insects. With this monocular he was able to observe their activities without influencing them by his presence. As soon as the glass was introduced, uses were found for it in other fields. Laboratories and industries are well represented, the telemagnifier making possible the accurate reading of thermometers and gages in otherwise inaccessible places, and the watching of parts of machines at a distance. The telemagnifier has an exceptionally long focusing range, quickly adjusted for varying distances. It is a prism glass, giving magnifications of from six to nine diameters, according to distance. Higher magnifications would make the field of view too small. Small and compact, it is easily used with one hand, and can be carried in a pocket.

Listening-in on the Human Heart

THE youngster of the adjoining photograph is listening-in on his own heart, with the help of a new piece of hospital equipment known as the stethophone. This apparatus is electrically operated, as is suggested by the "tea wagon" required to accommodate the batteries. The throbbing of the human engine is magnified three times by the instrument, and the double set of listening-in phones is considered a great advantage, enabling the doctor and the patient to consult over the heart action much more effectively than has been the case heretofore.

Decorating the Pies That Mother Used to Make

IT is quite the mode to call pancake flours or kitchen utensils after some old "Mammy" of the South, and so "Aunt Evelyn" is the sponsor for this clever little device. The action is plainly shown by our photograph. The prongs make the crimps so beloved by all pie fans and the outer edge is sharp enough to trim the excess pie crust as shown at the front of the pie. It can be used for cookies also.

Something a little more elaborate than the usual crimping iron

American Agriculture and Nitrogen Fixation

CONSIDERED broadly, there are three developments necessary before cheap fertilizer can be made available to the farmer. First is the perfection and expansion of the air-nitrogen industry to a point where it can produce cheap nitrogen, let us say, for example, at 5 cents per pound, a figure that seems well within reach. Second, production of cheap phosphoric acid or its equivalent to replace the present low-grade (16 per cent) acid phosphate; and third, elimination of all low-grade plant food materials from the fertilizer industry in order to cut out the present excessive freight and handling costs. These changes involve, on the one hand, rather radical departures from present practices, and on the other, education of the farmer to use high-grade materials effectively. For both these reasons, the changes will come gradually as the result of numerous developments and economic adjustments.—*Chem. and Met. Eng.*, 30:18, 4 pp.

Electricity for Any Oven

ANY oven may be converted quickly and economically into an electric oven by the aid of a device now offered by a Madison, Wis., manufacturer. A plug is furnished which attaches to the oven wall with a single screw; and a specially designed electric heating unit then is plugged in here. This heater operates from any 110-volt current supply. The outfit is used to electrify fireless cookers, enameling ovens, clothes dryers, water heaters, and all types of laboratory ovens.

Giving the patient the same chance to listen to himself as the doctor

Chromium Plating

WHILE chromium plating is as yet hardly a commercial process, it has been done very successfully. A great current density is used and the consequent large volume of hydrogen continually evolved at the cathode apparently provides the conditions necessary for success by preventing the chromium from oxidizing back and going again into solution. Chromium plating has been found to give protection in many cases where nickel and other protective coatings have failed. The chromium plate is hard and cannot be buffed or otherwise polished. This is more than made up for by the fact that if a polished surface is plated the resulting chromium surface will have a polish, without further mechanical treatment. The ability of chromium alloys to resist corrosion is even exceeded under certain circumstances by chromium-plated steel. There seems to be no doubt of its great value to the chemical engineer.

Silent Shackle Bolts

THE noiseless shackle-bolt nut, just introduced, is a device which effectively and permanently eliminates squeaks and rattles from loose shackle bolts and does away with the necessity for continually "taking up" and tightening these bolts. It is quickly and easily applied at the end of the springs, where the shackle is assembled. There are but four parts, all well designed and rigidly constructed of steel—two cups, telescoping into each other, a heavy coiled spring, and a blind hexagon nut.

Before applying, the cups are filled with heavy grease. By screwing up the nut on the shackle bolt to the desired amount, a tension is placed on the spring. This completes the installation, and no further attention is necessary. The tension of the spring prevents the nut from loosening and takes up all slack in the shackle assembly. The grease packing keeps the whole device perfectly noiseless. The user enjoys freedom from the squeaks and rattles which have always been both a source of annoyance and an expense. The outer surfaces of both cups and nut are heavily nickeled, adding to the appearance of the car.

Attachment that can be put in any oven to heat it electrically

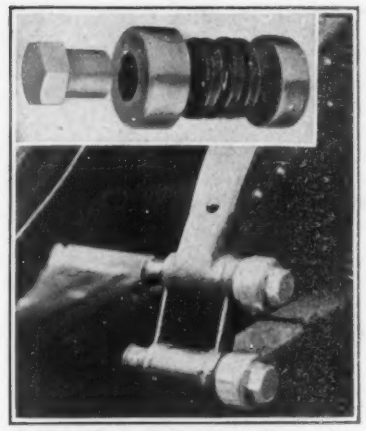
Producer-Gas-Burning Farm Tractors in France

A WAR loss of 1,400,000 men killed and far more than that incapacitated for active work has brought France to a realization that the man with the hoe must make way for the man with the farm tractor—and with all sorts of labor-saving farm machinery. Therefore she has been holding an agricultural exhibition and "selling" the idea of using machinery to the French farmer.

The anxiety of the French to make themselves independent of other countries in the matter of fuel supply for motors has led to some interesting developments in the application of gas from wood and charcoal to truck, tractor and stationary motors. Some of the manufacturers furnish gas producers using charcoal, only. This seems to be the more practical method of fueling motor vehicles as the necessarily reduced size of the generator calls for frequent recharging if wood is used.

If wood is used for gas generation the total weight of the combustibles is about the same as in the case of charcoal, for the latter requires about one and one-half times its own weight of water to produce the gas; while the moisture in the wood is quite sufficient to gasify all the fixed carbon, and no water need be added. Gas from charcoal as compared with that made when gasoline is evaporated reduces the power of the motor about 20 per cent, while this reaches 30 per cent in the use of gas generated from wood.

Practically all these French tractors which substitute gas made from wood or from charcoal are forced to carry a large and awkward looking generator, some of them, as illustrated in *Le Génie Civil*, Paris (84:15, 9 pp., ill.), taking up a large amount of space, others occupying what a seaman would call outboard positions, that is, hanging out to left or right, front or rear on brackets. This sacrifice to appearance is justified if a page of advertising issued by one manufacturer of French charcoal-produced gas may be taken as wholly accurate. Translated, this states, "Will you pay 100 francs to the American oil king—or 20 francs to the French charcoal burner?" This reflects in part the desire on the part of the French to secure a favorable trade balance, and so support the franc; and partly to a desire to be self-contained in time of war.



Taking the squeak out of the spring shackle with a bolt and nut of novel design

French tractor manufacturers are having a hard time with low-priced American competition. They do not get as much tractor out of a given amount of material as do the American makers. The only tractor design of which we have no satisfactory corresponding type in America is that of the combined agricultural and road tractor. It is a four-wheel drive affair, having two ranges of speeds—maximum road speed of about 15 miles per hour, and normal plowing speed of about four miles per hour. It is equipped with steel tractor-type wheels for plowing and for low-speed hauling, and an extra set of rubber-tired wheels for fast road-hauling.

Altogether, the recent French exhibition shows a determination on the part of the French to modernize their agriculture as much as possible, and to produce the machinery to do it with in France, both of which are laudable motives on the part of Frenchmen.

A Shock Absorber for the Hammer

OF course one can go on pounding all day with an old-fashioned hammer—it has been done millions of times. One can go on walking all day, on hard pavements, with leather or even wooden heels—that has been done, too. But the rubber heel makes the walking easier, and it seems a very plausible claim that the rubber buffer will make the hammering easier, by taking up the shock which must be transmitted to the hand when the blow lands. The rubber, be it noted, is carefully placed where it has

A rubber cushion for the absorption of the shock features this hammer

Putting a spontaneous pastime of the kiddies on a permanent basis

no effect whatever in the way of lightening the blow itself; it simply cushions the reaction. It lines the entire hole in the head through which the handle passes, projecting in the form of a collar below and a mere exposed edge above. Otherwise the design of the tool is unchanged.

A Change-Making Machine for the Subway

SUBWAYS and other enterprises that use a slot-machine turnstile find that there is still more delay and more personal handling of their patrons than they would wish, due to the necessity of making change for those who come, unequipped with the necessary nickel or dime. So the New York subway management has been experimenting with a money-changing machine, and now announces its impending installation. It, too, is a slot affair; you drop your dime or quarter or half-dollar in the appropriate receptacle, and your money's worth of smaller coins, including always at least one of the necessary nickels, is spilled out into the receptacle provided for the purpose. As in the turnstile slot-machines, there is an arrangement whereby each coin deposited is shown up, in its passage to the magazine, enlarged and brightly illuminated, so that the spotter who may be in the crowd can detect the attempt to beat the machines.

Experimental operation of these machines proved a conspicuous success. They are like the slot-machine telephone in that you can't get the coin in the wrong receptacle. But they will not, apparently, solve every problem of change-making. The passenger with nothing smaller than a bill, and the one with nothing larger than five pennies, will find that no provision has been made for them. Perhaps the cigar store on the corner will supply the answer, or perhaps one will have to be sure of having nickel or silver coins when one plans to ride in the tube after the elimination of the change window.

A Dynamic Plaything

PERHAPS you have seen the boys in your neighborhood rolling about inside old automobile shoes? Perhaps you have observed that the major difficulty of this sport is finding a secure hold on the smooth surface of the rubber? Perhaps you have seen the youthful rollers capsized out upon the pavement because of the failure of their grip on the revolving shoe?

Mr. E. F. Tinker, of Upper Montclair, N. J., saw all this, and it stirred his inventive mind to action. The result is the "Tinker tumbler" illustrated—patent applied for and coming along nicely. The kid who clamps himself on the inside of this is due for a somersaulting ride that will last as long as rotation continues—there isn't a chance in the world of shaking him loose. Mr. Tinker built one of them for the son of his own house, and found that the only difficulty lay in satisfying the demands of the other boys to ride in it.

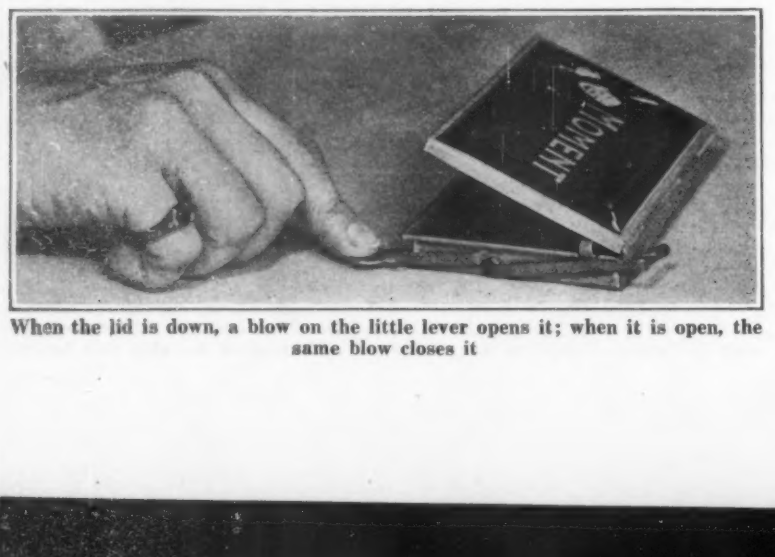
Get Your Distant Station Times

AN inventor of Brooklyn has devised an attachment for the radio which may be compared with the clock on the automobile as a convenience. The knob can be turned so that you can see at a glance what stations may be caught if they are broadcasting within the respective time-zones.

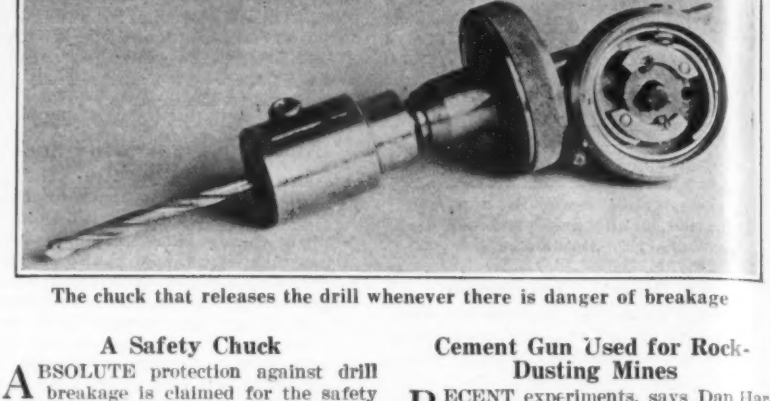
To get the correct time in the different zones, set the time finder at the time your watch or clock shows. The minutes before or after the hour can be ascertained by consulting your watch, as all time changes are even hours. For instance: If you live in, say, St. Louis, you are in Central Time. Set time finder at 3 o'clock Central Time, and you have the correct time in all other places on the dial, which is one-half the globe.

Put quarter, dime, or half-dollar in the appropriate slot, and get your change for the turnstile

The vacancies on the dial could be filled in, but are unnecessary for radio purposes. Then if it is 15 minutes after 3 at Central Time, it is 15 minutes after the hour in all the other zones.



When the lid is down, a blow on the little lever opens it; when it is open, the same blow closes it



The chuck that releases the drill whenever there is danger of breakage

A Safety Chuck

ABSOLUTE protection against drill breakage is claimed for the safety device illustrated herewith. Our photograph of the interior shows the central plate to which the chuck is attached; the pawls outside this, with their little steel inserts that fit into recesses in the plate; the pin on which the pawl hinges and the spring that holds it in place. Around the whole, and not clearly distinguishable in the picture, is a sort of piston ring, which carries the spring, and which is adjustable to the drill size, moving the spring nearer or farther away as the case may be.

In operation, the spring must hold the pawl insert in its recess, against the centrifugal and torsional force exerted by the rotating chuck. As soon as it is no longer able to do this, out the pawl comes; the chuck then rotates free, and the pawls cannot be engaged again without removing the drill from the hole. Inasmuch as the spring will always give before the drill will snap, anything that would ordinarily break a drill will simply throw this one out of engagement and bring it to a stop.

This little device keeps the radio listener-in free from confusion with the other fellow's clock

The Lid That Opens and Shuts With the Same Motion

WHEN the familiar inking pad is left open, it dries out; and when it is closed, it is a great nuisance to open it whenever it is to be used, and to close it again the next instant. An Austrian inventor provides a clever and simple little mechanical arrangement that simplifies the situation. When the cover is down, a sharp blow with the finger on the little lever will open it; and when it is open, another such blow will shut it. The secret lies in the little lug that is seen about four-fifths of the way back, along the lever arm. This lug assumes the function of driving member when the lid is closed, and through it a smart blow is delivered to the under side of the lid, throwing it open. But when it is already open, the lug hits thin air, and the other lever, out behind, delivers its blow to the outside of the open lid, pitching it over into closed position.

Cement Gun Used for Rock-Dusting Mines

RECENT experiments, says Dan Harrington, formerly of the Bureau of Mines (Bulletin 225) have been made in a New Mexico colliery with a cement gun stationed at the intake end of the main entry. It ejects a stream of dry shale dust into a strong ventilating current. The tests indicate that the shale dust was discharged at the rate of one ton per hour. The velocity of the air current in one test was 800 to 1000 linear feet per minute at the intake and about 400 linear feet at a point 6000 feet distant. The dust cloud at this point was dense 25 minutes after the cement gun was started, and definite evidence of dust settlement was found as far as 9000 feet from the gun.

It will be obvious that when the air current that passes through the entry being dusted is uniform, the quantity of deposited dust is necessarily greatest near the point where the dust is ejected. To obtain even distribution of dust through an entry, it would be necessary to shift the dusting machine from time to time. In an entry such as that described, of 98 square feet cross section and 6000 feet long, to obtain a deposit of, say four pounds per linear foot, at the rate of one ton (of 2000 pounds) an hour, the mechanical distributor would have to operate for no less than twelve hours.—*Coal Age.*

A Bridge Between Heel and Sole

THE unsupported foot is like a bridge with approaches and towers but no span. The device shown furnishes the span. The supporter consists of metal plates which are secured to the shoe, as shown, either by nails or screws. The plates hold removable rubber fillers of varying heights to fit the foot, thus furnishing an excellent arch support. Many foot troubles can be averted by this means and it is claimed that the life of the shoe is prolonged.

Completing the bridge effect of the shoe, making for foot comfort and longer shoe-life

The Heavens in September, 1924

The Physical Conditions Prevailing On and Inside the Larger Planets

By Professor Henry Norris Russell, Ph.D.

SINCE astronomy came to depend so much on physics, the greatest advance in our knowledge has had to do with the stars. Though they are so vastly distant, they are *hot;* and the light of a hot body tells us a great deal about its nature. The planets, though millions of times nearer than most of the stars, are cold; and their light, though carrying some traces of the atmosphere through which it has passed, still shows mainly the distinctive features of the sun, whence it originally sprang. To countervail this, the nearness of the planets enables us to measure their diameters, observe their surface markings and rotation, and find their masses. With the aid of this knowledge, we may infer a good deal regarding their physical constitution.

The four inner planets are denser than ordinary rock and must be solid bodies, like the earth. But the four outer, and larger, planets, are bodies of low density. Jupiter, Uranus and Neptune are all about as dense as the sun—that is, they average about 1½ times as dense as water; while Saturn is only about half as dense as the other three.

It has generally been supposed that this practically proved that these planets must all be very hot inside—not so hot as the sun, but hot enough to volatilize the material and impart to the gas a pressure great enough to bear up against the enormous gravitational pressure. And till recently it has also been believed that the planet's surfaces, too, were hot, though not hot enough to shine by their own light. But the work of Coblentz, who measured the heat which the planets send us, as discussed by Menzel, shows that almost all this heat is caused by the reflected sunlight, so little coming from the planets themselves that the surface temperatures of Jupiter and Saturn must be more than 100 degrees below zero. This does not prove that the interior may not still be hot, for the visible surface is obviously full of clouds; and deep layers of cloud would form a very efficient blanket to keep the heat in.

A Solid Jupiter?

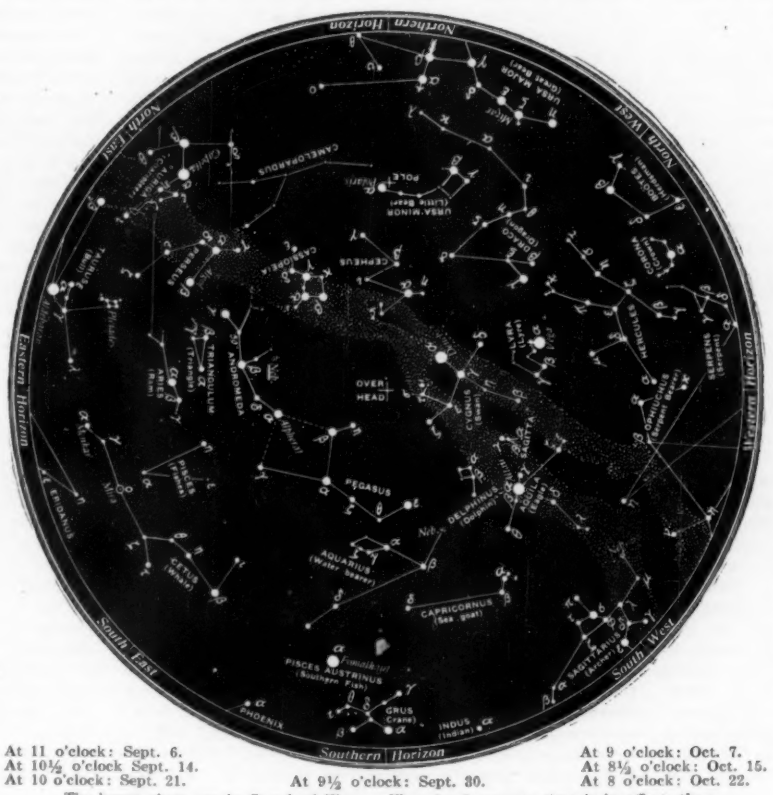
But now comes Jeffreys—a very capable English student of cosmical physics—and raises still more far-reaching doubts. He has recently pointed out that, even if the major planets were once hot, there is no reason why they should still be so. If Jupiter's surface is, and has been, only as hot as the earth's, a simple calculation shows that, during the billion or two of years for which it has probably led an independent existence, the planet must have lost heat enough to cool its whole interior by more than 100,000 degrees. This means, practically, that however hot the interior originally was, the outside must have cooled down to a temperature far below zero—a conclusion reached by Jeffreys before he knew of the observational proof.

Though cold, Jupiter's atmosphere must be very extensive, for there are not only great banks of clouds in it (forming the familiar belts, which are thousands of miles wide and stretch for a full quarter of a million miles around the planet), but also great winds. The equatorial belt streams eastward faster than the others, at a speed of some 200 miles per hour—which seems enormous but is only about twice that of terrestrial winds at the highest cloudline. Jeffreys calculates, on the basis of the (admittedly imperfect) existing theory of the winds, that this indicates a depth of more than 300 miles for Jupiter's atmosphere. What lies below this? Jeffreys, following out the bold but not unreasonable hypothesis that the planet has cooled down thoroughly, and is cold toward, if not at, the core, suggests that a great part of the planet's bulk may be composed of *ice*—one of the few solids of low enough density.

A later calculation of his—based not only on the density of the planet but also on the degree of concentration of its matter toward the center (which can be found from the flattening at the poles and the rate of rotation), shows that the known facts about Jupiter can be accounted for if it has a core of rock, of density three times that of water, 57,500 miles in diameter, covered by a layer of ice 11,000 miles thick and an atmosphere 3500 miles thick, making the diameter of the visible surface 86,500 miles. For Saturn, 73,000 miles in diameter, the rocky core comes out 31,000 miles in diameter, the ice-layer 12,500 miles thick, and the atmosphere 8500 miles deep.

There is nothing in these calculations, which are based on gravitational data, to prevent us from substituting an ocean 12,000 miles deep for the vast ice-cap suggested by Jeffreys, and this suggestion has been made many years ago, though not then backed up by mathematical work.

There are certain obvious difficulties about the new scheme. For example, at the bottom of an ocean 11,000 miles deep, under Jupiter's force of gravity, which is twice ours, the pressure would be fully 25,000 tons per square inch; and under this enormous pressure both water and rock would be made denser than under ordinary circumstances. And similar difficulties would arise about the pressure at the bottom of so deep an atmosphere. Dr. Jeffreys, who is doubtless quite as well aware of all these points as any of his critics can be, will presumably discuss them in detail later. Meanwhile it is of great interest to realize how manifold the possibilities are, how much we have still to learn, and how great an aid modern physical methods are in the learning.



At 11 o'clock: Sept. 6.
At 10½ o'clock Sept. 14.
At 10 o'clock: Sept. 21.
At 9½ o'clock: Sept. 30.
At 9 o'clock: Oct. 7.
At 8½ o'clock: Oct. 15.
At 8 o'clock: Oct. 22.

The hours given are in Standard Time. When local summer time is in effect, they must be made one hour later: 12 o'clock on September 6, etc.

NIGHT SKY: SEPTEMBER AND OCTOBER

The Heavens

Our map shows the appearance of the heavens at the hours mentioned below it. If one holds it right over his head, with the points of the compass in their proper directions (this explains the reversal of the ordinary relationship between north and east) it will reproduce as well as can be done on a flat sheet the appearance of the vault of heaven. The Milky Way stretches right overhead, from southwest to northeast. Along it, in order, lie the constellations of Sagittarius, Aquila, Lyra, Cygnus, Perseus, Cassiopeia, Cepheus and Auriga. The Great and Little Bears and Draco the dragon are in the north, and Hercules and Corona in the west-northwest. Pegasus is high in the southeast with Cetus below, and Aries and Taurus on the left. Aquarius and Capricornus are in the south, and lower down is the Southern Fish. The planet Mars, far brighter right now than anything else in the southern skies, is not on our map, because by September it will be in quite another part of the heavens.

The Planets

Mercury is an evening star when the month begins, but is already practically out of sight. On the 11th he passes between us and the sun; and he comes into sight as a morning star a week or so later. On the 27th he reaches his greatest elongation (17 deg. 52 min.) within an hour of his perihelion passage. He is unusually bright, because so near the sun, and should be visible as a star of the first magnitude, rising about 4:30 A. M.

Venus is a morning star, at her best—46 degrees from the sun at elongation on the 10th; and four times as bright as Mars, or nearly eight times brighter than Jupiter. She rises about 2 A. M., casts a strong shadow when shining through a window upon the opposite wall, and is easily visible in full daylight.

Mars is just past opposition, and is still the glory of the evening sky. Though not quite so near and bright as in August, he is still very favorably situated, his distance increasing from 35 to 44 million miles, and his brightness surpassing Jupiter's. The observations of which we spoke last month will be actively continued at many posts, while the amateur will have perhaps the best opportunity of all to see the planet well, and at a convenient hour.

Jupiter is in quadrature, east of the sun on the 3d, and so may be reckoned as an evening star. Being 22 degrees south of the equator, he sets early, about 9:45 in the middle of the month. Saturn is an evening star in Virgo, setting at 8:40 P.M. on the 1st, and 5:50 on the 30th.

Uranus is in opposition on the 12th, and is well observable, being in Aquarius, and only five degrees south of the equator—further north than he has been for more than 30 years. There are unfortunately no good sky-marks to aid in finding him. He may perhaps be found about two-fifths of the way from Delta Aquarii toward Gamma Pegasi, south of the oval ring of seven stars in the eastern part of Pisces (too faint to appear on our map) by about the length of the shorter diameter of this ring; but a good star-map, or else a set of sketches made with a field-glass at intervals of a week or so, will be required to identify him from among the fixed stars. Those who have telescopes with setting circles can find him at once; his position on the 15th being 23h. 22m. 21s. R. A. and 4° 56′ 10″ south declination, and his motion 8.8 seconds west and 56 seconds south per day.

With great telescopes he will be interesting to observe at this opposition, for we are very near the plane of his equator, and his satellites can be seen passing from side to side, almost in a north and south line, instead of circling about him in wide ellipses as they usually seem to do. This is also an unusually good time to measure the flattening of the planet at his poles; but observations of either class can be attempted only with very large instruments.

Neptune is just past conjunction, and rises at 3 A. M. in the middle of the month.

The moon is in her first quarter at 4 A. M. on the 6th, full at 2 A. M. on the 13th, in her last quarter at 11 P. M. on the 20th, and new at 3 P. M. on the 28th. She is nearest the earth on the 6th, and farthest away on the 20th. During the month she passes by Saturn on the 3d, Jupiter on the 5th, Mars on the 11th, Uranus on the 12th, Venus on the 24th (when there is an occultation visible in Europe and Asia), Neptune on the 25th, Mercury on the 27th, and Saturn on the 30th.

At 2:59 A. M. on the 23d the sun crosses the celestial equator and enters the "sign" though not the constellation of Libra; and "autumn commences."

How Metals Are Etched

ETCHING of metals, in other words eating away the surface of metals in order to reproduce thereon a design, has been practiced for a long time. The old masters, Rembrandt, Rubens, Raphael and many others did a great deal of work along these lines and developed the art of etching metal to a high state of perfection. Today the art is practiced by jewelers, manufacturers of jewelry and gold and silver ware of all sorts. There is scarcely an article made of any metal that cannot be etched and is not etched in some manner in order to enhance its appearance.

It is interesting to note that the word etching is derived from an old Dutch word, etsen, which literally means to eat. Thus the art of etching applies the application of some corrosive liquid to the surface of metal so as to eat out a design therein. There are many different substances that can be used for this purpose, and their selection depends on the metal that is to be worked as well as on the method that is employed in etching the design. It is understandable that the acid, which will etch copper perfectly, will not etch gold or platinum, or may not have any effect on zinc or silver.

There are two general processes of etching. In one, chemical agents only are employed. This is known as chemical etching. In the other the electric current is used as an aid to the chemical. This is called electrolytic etching. Chemical etching is of two kinds, relief and intaglio. In relief etching the design is drawn or painted upon the surface of the metal. This is done with a special, acid-resistant, varnish or gum preparation, which is painted over the surface of the metal. The rest of the metal is left uncovered and is eaten away by the acid, leaving the design in relief.

In intaglio etching the entire surface of the metal is covered with the varnish preparation and the design is cut into the same with the aid of a fine tool, which cuts away from the insulating covering and exposes the metal underneath. The acid is then applied to the surface and the design is eaten into the same in the manner of intaglio work.

There are many formulæ for making the etching ground. They all contain some kind of asphaltum, pitch, bitumen and the like. A good ground can be made from three parts of wax and four parts of asphalt. For special purposes, as in copper engraving and the like, special etching ground preparations can be employed. The preparation is painted on the surface or else it may be rolled over the same with a leather-covered roller.

The etching fluids are also of many kinds and many different compositions. Acids, such as nitric, hydrochloric and sulfuric, are employed.

In electrolytic etching an acid is not employed, but the article which is to be etched is covered with a varnish in the usual manner, and then immersed in a bath of a salt which, when the current is passed through the bath, produces an acid which is the correct one for eating the design into the metal. Thus it is important to select the proper electrolyte in accordance with the nature of the metal that is being worked. The results of electrolytic etching are excellent and in certain ways much better than those that are obtained in the ordinary chemical process.

The Hardness of Water. What Causes It and How It Can Be Removed?

THE laundryman and the housewife, who have to wash clothes and dishes, know well the disadvantages of hard water. The engineer is also cognizant of its drawbacks and the trouble it brings about not only in boilers during its conversion into steam, but in various industrial processes, particularly in the manufacture of textiles, calico printing, dyeing and finishing textile fabrics, where a soft water is essential to the success of the process.

Water is hard for natural reasons and when in the course of circumstances it happens that a hard water is encountered and must be used, because there is no other available, there is nothing left to do but to use it. Fortunately it is possible to remove the hardness of water by simple chemical means, which can be applied by the housewife and laundryman just as well as by the chemist or engineer in the industrial plant.

To understand how this can be done, it is necessary to know that there are two forms of hardness of water, temporary hardness and permanent hardness.

Temporary hardness is caused by the presence in water of a salt of calcium, known as calcium bicarbonate. This substance is soluble in water and when such water is used in washing clothes, the soap dissolves to form a scum instead of filmy suds when the water is soft. This film makes it difficult to clean dishes or wash clothes. Chemically the explanation is that the calcium soap, formed between the soluble calcium compound in the water and the soap itself, is insoluble in water and forms a precipitate.

To remove temporary hardness all that it is necessary to do is to boil the water. The calcium bicarbonate is decomposed to form an insoluble substance, calcium carbonate, limestone, chalk. This settles to the bottom of the vessel in which the heating is done and the supernatant water is quite soft. Now it will yield soap suds with soap and can be used for every purpose that water which is inherently soft can be employed.

Permanent hardness of water cannot be removed by boiling the water. Hence the significance of its name. A simple chemical process must be used to destroy the permanent hardness of the water. The substance that is responsible for the permanent hardness of water is known as sulfate of calcium. Sometimes sulfate of magnesium (Epsom salt) is the cause of permanent hardness. Both these substances are soluble in water and when soap comes into contact with such water, soap suds are not formed but a thick scum which makes washing clothes with the water a very laborious and difficult matter.

To destroy permanent hardness of water all that it is necessary to do is to add sufficient soda to change the sulfate of calcium or magnesium into the carbonate which is insoluble in water and precipitates to the bottom of the tank. The water is made absolutely soft by this treatment. No matter what the color, name or claimed powers of the water softening agent may be, it is the soda content of the same—and all generally contain soda—that determines its water-softening powers. In fact, generally most effective and economical results can be obtained by using common soda directly for water softening.

A Soap Free from Lye

SOAP is made from fatty and oily matters by a process known as saponification. The oils, fats, greases are treated with caustic soda which exerts a chemical action on the former, converting them into soluble salts, that dissolve readily in water. Saponification, which is the name given to this process, is simply soap-making, the transformation of insoluble organic matter into a solid substance with entirely different properties, soluble in water.

The process of soap-making consists in boiling up the fats and greases with the caustic soda or lye, evaporating the solution obtained until the soap is ready to set and allowing the same to solidify in large masses which are then cut into proper sized cakes. There are various other steps in the process which need not be discussed here, for they have no relation to our subject. In order to produce a soap which is free from uncombined caustic soda, great care is taken to add just the correct amount of the reagent which is required to combine with the fat or oil and convert it into a soap. When this is done, a soap is obtained which does not contain free, that is uncombined, lye.

The importance of having a soap that does not contain free lye, is evident when the action of lye or caustic soda on the substances that are washed with soap, is taken into consideration. Caustic soda has a distinctive effect on the human skin and hair, fine silks and wool, causing them to tender; that is, destroying their inherent strength. The life or lustre of the fabric is also destroyed. This chemical has a less potent action on the vegetable fibers, cotton and linen, but if present in sufficient concentration and if the clothes are washed often enough with a soap that contains considerable free lye, their strength and finish will also be gradually destroyed. (Caustic soda is the reagent that destroys all animal matter.)

There are many soaps on the market that are free from lye; that is, they do not contain uncombined lye. A simple test, made by dissolving the soap in alcohol, will show this to be true, for when a drop of phenolphthalein is added to the solution the characteristic red color reaction, indicating the presence of free alkali, that is lye, does not take place. But, when the solution of the soap in alcohol is mixed with water, then a distinct red coloration is produced, indicating that lye is present.

This seeming contradiction is easily explained. In chemistry there is a process which is known as hydrolysis. It takes place when a salt is added to water. If the salt is made up of a weak base and a strong acid, as for example, zinc sulfate, the solution of the latter will react acid; if the salt is composed of a weak acid and strong base, as for example, sodium carbonate, the solution will react alkaline; and finally if the acid and base reacting to make the salt are equal in strength, then the aqueous solution of the salt, sodium sulfate for example, will be perfectly neutral.

Soap is a salt of a fatty acid, either oleic palmitic or stearic, and generally a mixture of the three, according to what sort of raw material was used in the manufacture. These acids are very weak, while the alkali or base that is employed in the reaction, sodium hydroxide or caustic soda, is very strong. The result is that the perfectly neutral soap, that is, one containing no free, uncombined alkali, as soon as it dissolves in water, liberates lye, which is readily detected by the characteristic phenolphthalein color reaction.

A test was made with five different soaps. Three of these were toilet soaps of various grades, one a castile soap of the highest purity and the fifth the new product, known as the lyeless soap, developed by Dr. Maurice Aisen, well-known consulting chemist of New York City. Five beakers were used and a small amount of each soap was dissolved in a little water and then the volumes of the solution in all the beakers were made equal. A drop of a solution of phenolphthalein, which is perfectly colorless, is added to each beaker. Every one of the soap solutions turned a deep pink with the exception of that made with the lyeless soap. This test indicates that the hydrolysis of the four other soaps resulted in the formation of free alkali which was immediately and unequivocally detected by the phenolphthalein reagent. The amount of alkali that is liberated in this manner is said to be from 33 to 55 per cent of the weight of caustic soda used in making the soap.

The product that is called lyeless soap is a soap that does not contain any free alkali and that does not liberate free alkali dissolved in water. Hence, when washing with this soap, as the tests indicated, no alkali is released. The harmful effect of alkali in washing is common knowledge. Alkali possesses the power of saponifying the oils that are present in the skin and the hair with the result that after washing, the skin and the hair feel hard and dry, thus render them tender and brittle. Frequent washing has that effect, as doctors and others who wash their hands many times a day have testified. It is claimed, and the claims are substantiated by many testimonials from physicians and others all over the country, that the lyeless soap does not hurt the skin no matter how often used.

The lyeless soap of Dr. Maurice Aisen is made in an unusual manner, but the saponification that is carried out on the raw materials is of a modified nature. A product is obtained which looks like soap and acts like soap, but which is not really soap as it is commonly known. A test made with the lyeless soap to determine its cleansing power clearly demonstrated that it will remove dirt very effectively, that it produces considerable suds even in hard water. It does not feel like ordinary soap when washing. The hands rubbed with the soap have a sort of a creamy feeling and the soap does not sud at once, but creams and with more water it produces abundant heavy suds. This action is explained by the fact that the soap in the first instance is exerting its cleansing by high colloidal power and during this time its sud-producing power is lessened. Most soaps act in this manner.

The lyeless soap has been suggested for general toilet purposes and for medicinal use as well. It is claimed that diseased skin will be benefited by washing with this soap due to the fact that it does not produce any free lye when dissolved in water. It is also suggested that the soap can be advantageously employed in making dental creams, in the degumming of silk which is a very delicate operation, as the silk fiber is very tender. The soap is also recommended for use in washing textiles of all kinds; it is claimed to have no injurious effects on even the sheerest of fabrics and the finest of lingerie.

For washing the hair the lyeless soap has a very decided advantage over the usual run of soaps and shampoo preparations. Not only does it thoroughly cleanse the hair but leaves it in a soft, fluffy condition. For shaving, too, the lyeless soap performs very well indeed, not only during the actual shaving operation but as far as the after effects are concerned.

Dr. Aisen has been closely identified with several important chemical developments, in the capacity of consulting chemist. He has done considerable work in the past on the problem of producing synthetic jewels.

The Service of the Chemist

A Department Devoted to Progress and Achievement in the Field of Applied Chemistry

Conducted by ISMAR GINSBERG, Chemical Engineer

Patching Platinum Dishes

IT has been recommended that gold be used as a solder in patching platinum evaporating dishes. For this purpose a piece of fine gold is beaten out into a sheet of approximately 0.1 millimeter thickness and from this sheet there is cut a strip about half a millimeter wide and somewhat longer than the crack in the dish that it is desirous to repair. Then the dish is held in a position so that the bottom points upwards and the strip of gold is laid right on the part that is being repaired. The platinum is then heated with a blast lamp and after a few seconds, the gold melts and fills the opening in the dish. For further details the reader is referred to Mitt. Geb. Lebensmittelunter und Hygiene, 1923, volume 14, pages 367-8.

Effects of Tannic Acid on Concrete

IT is well known that certain organic substances have an adverse effect upon the strength of concrete, and a case is on record of a concrete flooring failing owing to the continued action of sugar.

Quite recently a study was made of the effect of tannin on the strength of concrete, tannin being taken as typical of an organic substance. For many types of concrete mixtures, it is shown that even less than a tenth of 1 per cent of tannin on the weight of the aggregate will materially reduce the strength of the concrete, tests being made over a period of two years. The action of the tannin appears to be in some way dependent upon the size of the aggregate particles.

The results obtained bear out those already known with other organic substances, and from the practical standpoint show that the use of sand contaminated with organic impurities is not to be recommended. Incidentally a test should be made of the availability of sands for concrete manufacture. This may be done in the following manner:

A twelve-ounce medicine bottle is filled to the four-ounce mark with the sample and then a 3 per cent caustic soda solution is added until the seven-ounce mark is reached. After well shaking, the bottle is allowed to stand for 24 hours, when the color of the liquor is noted. If a dark color, the sand should not be used for high-grade concretes.—*The Chemical Trade Journal.*

Simple Test for Boiled Oils

THE following test for distinguishing between a crude vegetable oil and one that has been heat-treated is given in the *Revue de Chemie Industrielle*, March, 1924.

A reagent is made by dissolving one cubic centimeter of freshly distilled aniline oil in ten cubic centimeters of carbon tetrachloride. A few drops of a solution of bromine in carbon tetrachloride are then added until a white precipitate is formed. This white precipitate is then redissolved in a slight excess of the aniline. A few drops of this reagent which possesses a slight yellowish color are added to the oil that is to be examined. With a boiled oil, such as boiled linseed oil, a deep brown coloration is formed, whereas with a crude oil no color is formed. The formation of the color is ascribed to the peroxide groups which are present in the boiled oil, and it is suggested that a reaction similar to that involved in aniline black formation takes place.

Insulation of Water Piping

WATER piping is well protected against frost, according to a German report, by covering the same with plaited straw rope. Kieselguhr preparations were found to be unsuitable for this purpose.

New Sulfuric Acid Process

THE Schmiedel process for making sulfuric acid is a recent importation of particular interest to metallurgists, because it is designed to work efficiently on gases of variable or very low sulfur dioxide content. It employs the familiar nitric acid as oxidizing agent, but dispenses with the chamber, for which it substitutes mechanical means of securing thorough and intimate contact between gases and reagent. A revolving drum, dipping into the acid bath, presents a thin and constantly renewed film of acid to the gas stream, which also necessarily comes in contact with the bath itself. The process is offered for the treatment of gases as low in sulfur dioxide as 1.5 per cent, and in capacities as small as five tons of acid per day, and is designed to produce any strength up to 60 degrees Baumé. It may find considerable use in adding to outputs of existing chamber plants, or as a substitute for them, but its special appeal is to the metallurgist whose attention is fixed on contents other than sulfur, and whose furnaces are not run primarily to supply a gas of uniformly high sulfur dioxide content.—*Mining and Metallurgy.*

A New Motor Fuel

ACCORDING to *Brennstoffchemie*, 1924, page 276, a new motor fuel has been put out on the market under the name of synthol. This fuel is made by the reduction of carbon monoxide which is obtained from ordinary water gas and which is subjected to a pressure of 150 atmospheres at a temperature, varying from 400 to 450 degrees Centigrade, in the presence of a catalyst. The catalyst is made of iron filings which are covered with a coating of potassium carbonate. Synthol consists of a mixture of low molecular weight acids, alcohols, aldehydes, esters, hydrocarbons, etc. It is claimed that a mixture of synthol and benzol in equal parts makes a very satisfactory motor fuel.

Motor Fuel from Rubber

IT is reported in the *Oil, Paint and Drug Reporter* that a chemist working in the rubber plantations in the Federated Malay States has developed a process for the extraction of an oil from rubber scrap. This oil, it is claimed, may be substituted for gasoline as a motor fuel and also is used to combat mosquitoes in the place of petroleum products.

Removing Taste from Codliver Oil

A RECENT discovery made by a Norwegian chemist has made it possible to remove the disagreeable taste from codliver oil and thereby make it suitable for use in a variety of food products, including its substitution for the products now used in the manufacture of margarine. The process involves steaming, it is said, and will also make it easier for folks to take codliver oil for malnutrition, in addition to opening up an entirely new field for this by-product of the cod fisheries, as indicated above.

New Krypton Uses

THE use of krypton for obtaining radio photographs has been recently suggested. It is suggested that salts with high molecular weight (bismuth carbonate, barium sulfate) are now being used for diagnosing various illnesses. These salts introduced into the various cavities of the organism permit the obtaining of radio photographs, with shadows locating the position of the organ. The absolute inactivity of krypton from the chemical point of view gives it a superiority over the salts of bismuth or barium, which are more difficult to use than a gas.

Thermal Conductivity for Gas Analysis

AN electrical method of gas analysis recently perfected at the Bureau of Standards of the Department of Commerce makes possible the immediate detection of the change in composition of flue gases in a boiler plant, the recording of such changes throughout the day, and the manual or automatic control of regulating apparatus in accordance with gas composition. Other industries in which the new method is expected to prove useful are the manufacture of oxygen and hydrogen by the electrolytic method, the manufacture of sulfuric acid, and of synthetic ammonia, and the extraction of helium from natural gas for use in balloons and airships.—*Technologic Paper* No. 249, Bureau of Standards.

Electroplating of Aluminum

A METHOD of electroplating of aluminum, which was reported in an address delivered before the American Electroplaters' Society, is somewhat as follows:

Ordinary rolled sheet aluminum plates, after being scratch-brushed with a steel brush, are first suspended as anodes in a solution of sodium hydroxide of about two per cent strength at a temperature of from 25 to 35 degrees Centigrade, and a current of about 23 amperes per square foot is allowed to flow for 12 minutes at a voltage of 28 to 36 volts. They are then transferred to an ordinary copper cyanide bath, and are plated for three minutes with a current of 2.5 amperes per square foot at 1.75 volts. The coating is finished in an ordinary cold copper sulfate bath in the usual manner.

Extinction of Fires by Liquid Carbon Dioxide

A REPORT from the Mellon Institute of Pittsburgh describes a method for extinction of fires in mines by the aid of liquid carbon dioxide. The method has been tried before but the results have not been very conclusive, as sometimes they were successful and other times they were not. In the experiments which were made at the Mellon Institute, carbon dioxide from cylinders was discharged into the mine, the area on fire being isolated by brick stoppings. The effect of the carbon dioxide is to prevent inward leakage of air, so that if each pound of gas so introduced prevented the entry of an equivalent volume of air, the generation of roughly 600 B. T. U. is prevented. After all flame was extinguished, water was used to enable the mine to be opened without delay. The results of the experiment show that carbon dioxide should be used where the fire can be sufficiently restricted by stopping, so that prohibitive amounts of gas are not consumed. Further with the use of the gas, a saving is effected because the mine can be opened more quickly, depreciation of the mine due to roof falls, etc., is decreased and less coal is wasted.

Oxychloride Cement Tests

COMPARATIVELY few users of oxychloride cement tests are really familiar with it. Even among architects and builders oxychloride cement products are often known only in connection with trade names. The rapidly increasing demand for these materials shows that they possess certain desirable properties and peculiarities, and has made it necessary to replace the hap-hazard or "rule-of-thumb" methods that have hitherto been employed in the manufacture and use of this cement with more scientific methods based on the studies of numerous tests. In carrying out tests of caustic magnesia made from magnesite from several sources the United States Bureau of Standards made caustic magnesia, the chief constituent of oxychloride cement, in the experimental cement plant of the Bureau by calcining magnesite ore. The temperature and the other conditions were varied in order to study the effects on the properties of the product. An ore imported from Greece, one shipped from the State of Washington, and two from different mines in California were used, as these were representative of the chief sources of supply for this country. Cement mixtures typical of those used by the trade, were then made, and tested both in the laboratory and on panels of flooring and stucco exposed to actual service conditions. The results of this work form an important contribution to the information necessary for the production of the most satisfactory oxychloride cement products, and are contained in Technologic Paper No. 293, which may be obtained from the Superintendent of Documents, Washington, D. C.

Dried Yeast As Supplement to Good Poultry Laying

TEN pens (forty-five birds per pen) of white leghorn pullets and hens were fed for ten months on wet and dry mash rations, with and without yeast and with and without artificial lights. Biometrical methods were used in interpreting the data with regard to body weight, egg production, size and weight of eggs and food intake. Practically all groups, receiving yeast, showed a response, although in some cases the differences were not great. When pullets were subjected to longer feeding periods by the use of electric lights, significant differences were obtained in favor of the yeast fed hens.

While on the subject of yeast, it will interest our regular readers to learn that a special article dealing with the intricate and interesting manufacture of commercial yeast will appear soon.

Recently Patented Inventions

As a convenience to our readers, we will supply copies of any patents listed herein for 15 cents each. The official printed copies of patents include complete descriptions and drawings of the inventions disclosed. State the patent number to insure receipt of the desired patent copy.

Pertaining to Apparel

BELT BUCKLE—Which will remain in adjusted position about the waist of a wearer. Patent 1494288. C. Rosenblum, 255 Colyer St., Brooklyn, N. Y.

PROTECTOR FOR APIARISTS — Including a garment and a head screen, and means to maintain the screen away from the face. Patent 1494249. V. M. Johnson, Greenville, Miss.

SOFT-TIP LADY'S HAT LINING—Characterized by a one-ply thickness of fibrous material forming a band and crown stitched together. Patent 1495006. I. Ephraim, Ave. D and 10th St., College Point, N. Y.

STOCKING PURSE—Adapted to be connected with the top of a stocking without injuring the same. Patent 1495068. C. De Murguiondo, 43 St. Johns Place, Brooklyn, N. Y.

ATTACHMENT FOR BRASSIERES—To be applied to the brassiere strap to make impossible the lateral displacement over the shoulder. Patent 1496705. Ella F. DeForest, 956 Main St., Stamford, Conn.

Electrical Devices

MOTOR CONTROLLER—Whereby the direction of motion of a motor may be easily reversed. Patent 1494230. H. N. Fochs, 113 E. 75th St., New York, N. Y.

ARC LAMP CONTROL SYSTEM—Which will enable the length of an arc to be advanced by steps, and maintained. Patent 1494272. L. E. Miller, 525 E. Columbia St., Alliance, Ohio.

ELECTRICALLY OPERATED PHONOGRAPH—In which an electric motor operated from an ordinary lighting circuit is employed for actuating the device. Patent 1494819. S. D. Shobe and F. L. Kohn, Glenmore, Ohio.

CONNECTING MEMBER—Of such nature as to permit the quick association of two electrical conductors. Patent 1495017. O. Gentsch, Magdeburg, Germany.

FLOAT-OPERATED CIRCUIT CLOSER—Which automatically sounds an electric buzzer when oil in the crank case of an automobile has reached a predetermined level. Patent 1497,712. C. E. and F. M. Crandall, Laporte, Minn.

VACUUM-TUBE ADAPTER—For connecting various types and sizes of vacuum bulbs into the receiving and transmitting circuits of wireless sets. Patent 1498500. F. Wilhelm and W. Schwarz, 602 3d Ave., New York, N. Y.

SPARK-PLUG TESTING AND INDICATING DEVICE—Whereby the functioning of each plug may be continuously indicated to the driver. Patent 1495436. E. M. Plummer, 3714 Herndon St., Chicago, Ill.

CHART FOR TUNING RADIO SETS—In which a plurality of dials may be turned to a defined wave length, individual to a station. Patent 1495843. C. F. Hanselmann, 1301 40th St., Brooklyn, N. Y.

Of Interest to Farmers

TRACTOR HITCH—Permitting the attachment of various types of plows and other agricultural implements to a tractor. Patent 1494268. T. Mendenhall, Ridge Farm, Ill.

PLOW—Adapted to perform various operations, without requiring several different types of plows. Patent 1494844. R. L. Johnson, Route B, Box 3, Atmore, Ala.

GRAIN SACKER—Operable by one man thus effecting economy of both time and labor. Patent 1495886. E. Craite, c/o Craite & Son Milling Co., Rice Lake, Wis.

PLANT-SETTING MACHINE — For transplanting young cabbage, celery or similar plants, and giving an initial watering after the resetting. Patent 1495328. L. F. Keppler, Box 2A, R. 1, Sanford, Fla.

BOLL WEEVIL TRAP — Adapted to be drawn along in engagement with the growing plants for dislodging the boll weevils and imprisoning the insects. Patent 1496,386. R. A. Sligh, 1642 Main St., Columbia, S. C.

DEHORNER—Which will insure a clean cut, preventing crushing of the horn. Patent 1496680. T. R. Seamon and J. H. Donaldson, c/o J. H. Donaldson, Silver City, Nevada.

DOCKING MACHINE — Particularly constructed for the docking of lambs. Patent 1497,975. R. Flick and W. M. Browning, c/o Morris, Hurd & Rhoades, 3-8 Odd Fellows Bldg., Great Falls, Mont.

Of General Interest

LOCKING DEVICE FOR SHAKER TOPS—For use in connection with condiment holders, for the ready attachment or detachment of the top. Patent 1490823. S. Haslam, c/o Evans Case Co., North Attleboro, Mass.

REVERSIBLE PLUG FOR CONDENSER TUBES AND THE LIKE—For closing the ends of different sized tubes of surface condensers. Patent 1490869. W. E. VOLZ, 51 Maiden Lane, New York, N. Y.

MAILING DEVICE — For containing registered mail, in which a return receipt card is enclosed. Patent 1491675. V. A. Conklin, 513 5th Ave., Belmar, N. J.

INKWELL—Having a cover connected with a pen holding rack, closed when the pen is on the rack, open when pen is removed. Patent 1491645. J. E. Turner, Maben, W. Va.

VANITY CASE—Having compartments for a powder cake, rouge, a lip stick, and means for applying the articles. Patent 1498475. A. Mosheim, 110 No. 19th St., East Orange, N. J.

ERASER—With clamping means adapted to permit rotation of the blade to a new edge portion. Patent 1491720. G. C. Muirhead, Stockgrowers State Bank, Worland, Wyo.

HEEL TREAD PAD FOR HORSESHOES—Particularly designed for use in connection with drive calk shoes, and readily attached or removed therefrom. Patent 1492525. J. W. Miller, c/o Hall & Sargent, Red Wing, Minn.

FOOT SCRAPER—Which may function as a door mat, will be self-cleaning and may be exposed to the weather. Patent 1492526. O. L. Morsen, 335 Summer St., Akron, Ohio.

MILK TICKET HOLDER AND PROTECTOR—Readily engageable with and removable from the neck portion of a milk bottle. Patent 1492422. E. B. Carter, 1404 No. East St., Bloomington, Ill.

ICE CREEPER—Which may be quickly applied, firmly held on the ball of the foot and easily removed. Patent 1492513. A. F. Groebl, 175 School St., Oyster Bay, N. Y.

DAUBER FOR APPLYING SHOE POLISH AND THE LIKE—Capable of use in connection with a bottle for discharging the contents through the dauber. Patent 1492873. R. M. Watkin, 6 W. Main St., Herington, Kans.

HAIR CURLER—Formed of wires secured in such manner that the hair will not be injured or become disengaged. Patent 1492895. L. P. Putt, 215 No. 4th St., Toronto, Ohio.

CLOTHESLINE HANGER—Which may be secured to a window frame and swung in or out of the window. Patent 1492704. W. Dietzel, Merrick, L. I., N. Y.

SHOE FASTENER—Readily applied to an ordinary shoe, effective in facilitating the lacing and removal of the shoe. Patent 1493345. L. Kern, 4713 Northwood Ave., Frankfort, Philadelphia, Pa.

ENVELOPE—Formed from a continuous strip of material of a width equal to that of one envelope. Patent 1493432. R. N. Geffroy, 130 Wadsworth Ave., New York, N. Y.

SHOWER HEAD—For baths, which prevents the prolonged dripping of water after the flow has been discontinued. Patent 1493359. S. W. Mallery, 9 Workmans Circle, Liberty, N. Y.

PHOTOGRAPHIC CAMERA—Of the roll film type, whereby overwinding or underwinding is prevented, also deterioration of the sensitized film. Patent 1493334. G. T. Fielding, 20 W. North St., Stamford, Conn.

HANDLE—For cooking utensils, to prevent burning the hands of the user. Patent 1493360. C. B. Maloy, Villard Ave., Hollis, L. I., N. Y.

INSECT TRAP—Which affords facilities for exterminating flies and like insects in a sanitary manner. Patent 1493132. R. R. Strong, Anaconda, Mont.

SPOOL—Constructed of light paper yet possessing great rigidity. Patent 1493348. F. Kuhlmann, 300 E. 159th St., New York, N. Y.

LADDER—Of the extension type which may be readily assembled and disassembled. Patent 1491648. W. J. Wayne, 424 E. Waggoner St., Decatur, Ill.

AIR-CIRCULATING SYSTEM FOR CARGO VESSELS—Accomplished by forming in each end of alternate decks, openings communicating between compartments above and below. Patent 1491750. J. Hudson, 404 61st St., Brooklyn, N. Y.

COFFEE-MAKING APPARATUS — Having means for siphoning the coffee liquid through the grounds, without draining and repouring the liquid. Patent 1494014. G. P. Petropulos, 3329 Beach Ave., Chicago, Ill.

COMBINED KEY CASE AND FLASH LIGHT HOLDER—Readily held in a manner to permit of directing the rays on the lock, while inserting the key. Patent 1494242. A. B. Hill, 442 Greene Ave., Brooklyn, N. Y.

WRITING APPLIANCE—Adapted for shorthand writers in court reporting, presenting a fresh writing surface without the turning of pages. Patent 1494292. E. H. Schait, 3517 Eastern Ave., Belle, Md.

CLOTHESLINE SUPPORT AND HANGER—Affording means for hanging or moving clothes without leaning out of the window. Patent 1493540. A. Heyman and C. C. Vervoort, 142 Newell St., Brooklyn, N. Y.

ENVELOPE — Suitable for attaching to packages so that both may arrive and receive attention simultaneously. Patent 1494837. O. C. Warner, Boulder, Colo.

CONCRETE MOLD—For use in construction of reinforced concrete joists for floor slabs. Patent 1494538. O. L. Gent, 214 New Ault Bldg., Tulsa, Okla.

ROLLER CANE—Adapted for use primarily by blind persons that the user may be guided in traveling. Patent 1494508. H. C. Smith, 814 W. Market St., Aberdeen, Wash.

BUILDING—Designed for general storage but more especially for the storage of automotive vehicles. Patent 1494537. J. J. Geffney and C. J. Epping, Louisville, Ky.

SIPHON CREAM REMOVER—Which is readily adjusted and will automatically start the siphon action when inserted within a milk bottle. Patent 1494737. J. H. Cournyer, c/o Skimit Mfg. Co., Oskaloosa, Iowa.

SEPARABLE FASTENER—For use as a jewelry clasp of the type employed on wrist watch bands. Patent 1495118. J. R. Starck, Box 112, Weehawken, N. J.

PENCIL—In which the holder is entirely free from springs or similar devices, likely to clog the lead. Patent 1494999. W. T. Crouse and P. L. Meyer, 4509 Alice Ave., St. Louis, Mo.

BAG HOLDING CABINET—Which affords facilities for holding folded paper bags, envelopes or the like to be withdrawn in sequence. Patent 1495670. F. Burridge, c/o Brandon & Davey, 209 B. C. Permanent Loan Bldg., Victoria, B. C., Canada.

KNOCKDOWN BARREL — That may be quickly disassembled and the sections nested to occupy a minimum of space. Patent 1495937. G. E. Wakeman, c/o A. F. Simonson, Savings Bank Bldg., Stapleton, S. I., N. Y.

CATALOG—So constructed that the publication is sealed and ready for mailing without the use of an envelope. Patent 1495831. H. B. Abel, Box 116, Valley Stream, N. Y.

FIGURE—Taking the form of a quadruped, for use in connection with carousels. Patent 1495917. W. F. Mangels, 2863 W. 8th St., Coney Island, N. Y.

CREAM REMOVER — For removing the cream that rises in the average bottle of milk, without intermixing the milk. Patent 1496300. J. H. Cournyer, c/o Skimit Mfg. Co., Oskaloosa, Iowa.

DOOR GUARD—Which will prevent the hubs of a vehicle from striking the uprights of the door. Patent 1496626. T. J. Coe, 1905 River View Drive, Endicott, N. Y.

BINDER—By means of which loose leaves may be positively secured in operative position. Patent 1496629. D. T. Helprin, 27 Warren St., New York, N. Y.

CLOSURE OPERATOR—For use in connection with the closure of receptacles, such as inking pads. Patent 1496702. F. Zilker, 622 Audubon Bldg., New Orleans, La.

HORSESHOE—Provided with a removable combined toe calk and clip, for preventing the foot from being clogged with dirt or stones. Patent 1496622. W. J. Cahill, Apt. D2, 77 Alsop St., Jamaica, N. Y.

PENCIL—Adapted to hold a plurality of pieces of lead, any one of which can be moved into position for use. Patent 1496,031. H. W. Siemund, 2714 Florence Ave., Chicago, Ill.

INDEX TAB—Which can be removed from its place without disturbing its respective column. Patent 1495401. F. A. Cushing, 2718 California St., San Francisco, Cal.

PERCOLATOR ATTACHMENT—Adapted to be so positioned that the water and steam are utilized to a maximum degree. Patent 1497,522. J. C. Luedke, 932 No. 11th St., E. Cedar Rapids, Iowa.

CARBOY—In which dowels are used to engage and hold the bottle in place resiliently. Patent 1497518. C. Lefkowitz, c/o Natl. Box & Lumber Co., 30 South St., Newark, N. J.

WINDOW — Having sliding sashes, and a novel mode of hanging and arranging the counterweights. Patent 1497517. L. Lane, Box 1066, Habana, Cuba.

CONCRETE CONSTRUCTION—Which may be built into standpipes, tanks, towers and other reservoirs. Patent 1497589. A. H. Reeves, Box 1028, Wilson Dam, Florence, Alabama.

POSTAGE-STAMP-CASE CAP — Adapted to be mounted on a fountain pen or the like. Patent 1497593. A. E. Rope, 613 Rugby Road, Brooklyn, N. Y.

COMBINATION BRUSH AND COMB FOR HATS—So constructed that they may be mounted in the hat without interfering with the wearer. Patent 1497524. L. McSweeney and A. Wilson, c/o J. M. Danziger, 120 Broadway, New York, N. Y.

SAFETY RAZOR—Constructed to convey the lather removed from the face to the opposite side of the blade. Patent 1497599. E. H. Sichel, 478 State St., Brooklyn, N. Y.

SAFETY RAZOR—In which the distance between the blade and the safety comb may be varied at will. Patent 1497590. Marie-Louis Riviere, 16 Boulevard de Strasbourg, Paris, France.

FASTENER FOR DOORS AND THE LIKE—Which will secure a closure when in partially opened position preventing entrance. Patent 1497500. L. H. Gorowitz, 9572 Oakland Ave., Detroit, Mich.

CIGAR CABINET—Having means for delivering the cigars in single succession through the top of the cabinet. Patent 1498476. J. Nadwocki, R. F. D. No. 2, Union Hill, Broadalbin, N. Y.

PAINT PADDLE — Constituting a paint stirrer as well as a scraper and cleaner for paint cans. Patent 1498509. W. L. Arnold, Howland Ave., Jamestown, R. I.

DEVICE FOR SORTING AND CARRYING MAIL—Primarily intended for the use of rural carriers, to prevent mistakes and facilitate delivery. Patent 1498455. E. B. Johnson, 1218 E. 67th St., Seattle, Wash.

COLLAPSIBLE BOX—Which when extended to operative position affords a relatively rigid container. Patent 1498441. C. A. Fox, 361 W. 26th St., New York, N. Y.

VANITY CASE—Constructed with spring pressure acting to force the powder upwardly as it is consumed. Patent 1498470. G.

E. Mignon, c/o P. H. Smart, Pratt & McAlysin, 120 Broadway, New York, N. Y.

GENERAL PACKAGE AND BOTTLE CARRIER—Whereby a plurality of articles of various sizes and shapes may be conveniently carried by hand. Patent 1498247. R. R. Stewart, 210 Caples Bldg., El Paso, Texas.

WRIST-WATCH BAND—Comprising a rectangular keeper with resilient tongue forming a readily releasable catch. Patent 1498,126. H. K. Smith, 56 Pier Ave., Hermosa Beach, Cal.

Hardware and Tools

AWNING SLIDE—In the form of a metal socket for connecting the frame and the slide rod. Patent 1494284. F. Ramstead, 519 E. 79th St., New York, N. Y.

VALVE FACING TOOL—For use in refacing valves of the type used in internal combustion motors, and the like. Patent 1495124. F. Wendling, 9317 87th Ave., Edmonton, Alberta, Canada.

DRILL APPARATUS—Wherein a number of drills may be nested in a comparatively small space. Patent 1495085. I. A. Lake, 3342 Hull Ave., Bronx, N. Y.

FAUCET—For coffee urns, providing means whereby coffee and milk are dispensed simultaneously. Patent 1494395. J. V. Wells, 161 W. 36th St., New York, N. Y.

RAZOR-BLADE SHARPENER—For facilitating the proper drawing of a blade over a strop, or sharpening element. Patent 1495,833. A. Alcorta, 828 President St., Brooklyn, N. Y.

SCRAPER—Combining in one tool means for performing the work of a plurality of tools in mining operations. Patent 1497055. T. J. Avery, Albia, Iowa.

METAL SASH — Providing a maximum strength while using a minimum of metal. Patent 1497516. L. Lane, Box 1066, Habana, Cuba.

FASTENER—For miscellaneous uses, being in the form of a repeatedly usable latch. Patent 1497663. N. B. Piersall, 227 Main St., Orange, N. J.

METHOD OF MAKING AIR-SPACE BETWEEN PLATES—The plates having integral projections, thereby forming spaces for the circulation of air or liquid. Patent 1497530. F. Mortensen, Helsingfors, Finland.

TOOL HOLDER—Adapted for use with lathes, boring machines, and the like, for firmly holding the tool in any desired position. Patent 1497746. W. Sury, Lengnau, Switzerland.

CHOKER HOOK—With latch mechanism which may be disassembled by the use of tools ordinarily available. Patent 1498230. H. W. Buzzard, Dock and Maple Sts., Bellingham, Wash.

BACKPLATE FOR GOOSENECK ROD BRACKETS—Wherein a plurality of screw receiving apertures are provided, all or part being used in securing the curtain rod support. Patent 1498456. G. Kroder, 107 E. 17th St., New York, N. Y.

Heating and Lighting

WATER FEED FOR BOILERS—For embodiment in a feed for boilers furnishing steam for power. Patent 1495942. W. A. Whitmore, Nelsonville, Ohio.

METAL-WORKING FURNACE—For use in the manufacture of wrought iron, properly mixing the batch, and carry out the complete operation. Patent 1497696. O. S. Pulliam, c/o Hibbard Process Corp., 71 Broadway, New York, N. Y.

Machines and Mechanical Devices

APPARATUS FOR FORMING CHAIN LINKS—An object being to cheapen the cost of manufacture. Patent 1491662. J. Billingham, c/o L. Bauer, 101 E. Moler St., Columbus, Ohio.

PUMP—Especially adapted for pumping water from a great depth. Patent 1491057. B. F. Myers, Marshall, Texas.

AUTOMATIC LIQUID DISPENSING APPARATUS—In the use of which the purchaser inserts a proper coin for the amount of gasoline required. Patent 1491054. W. R. Moore, 104 Northeast St., Fayetteville, Ark.

BEATER—For use in connection with the preparation of articles of food. Patent 1490980. A. W. Minney, 319 Clay St., Dayton, Ohio.

BAILER BOTTOM—Adapted for bailing oil or other wells of mud or sludge. Patent 1490959. A. Boynton, 1800 San Pedro Ave., San Antonio, Texas.

CONCRETE MIXER—Including an oscillatory drum having novel agitator elements. Patent 1490952. G. W. Adams, 158 Rockwood Court, San Antonio, Texas.

SAWING MACHINE—For use in connection with pile-driving rigs, for cutting off the pile tops. Patent 1492001. A. M. Signalness, Box 734, North Bend, Oregon.

LEAF-SPRING-BENDING DEVICE — Adapted to bend a leaf-spring of any size into any curvature desired. Patent 1493135. A. Walradt, c/o J. A. Elston, Caldwell, Idaho.

WIRE TWISTING MACHINE—Constructed to twist wire, wire cable, hemp and manila ropes without first winding the same on spools. Patent 1491483. A. Leach, 707 No. Sheridan Road, Kenosha, Wis.

MANUFACTURE OF RELIEF ENGRAVED PRINTING CYLINDERS—Whereby the cylinder is rendered absolutely true and even to insure perfect impressions. Patent 1492141. E. T. Neben, 19 Overbrook Road, Ridgewood, N. J.

CLOTH-TENTERING APPARATUS — For stretching and drying a continuously moving cloth web. Patent 1492480. G. W. Robertson, c/o Riverside & Dan River Cotton Mills, Danville, Va.

REFILL MECHANISM FOR FOUNTAIN PENS—Of the presser-bar type for collapsing the sac and filling the same with ink. Patent 1492451. W. E. Guyot, c/o Parker Pen Co., Janesville, Wis.

ROTARY BOX-BLANKING MACHINE—Designed to automatically cut slots, crease and trim a blank ready for folding into a box. Patent 1493404. L. H. Schroeder and J. Wagner, c/o Progressive Corrugated Paper Machinery Co., 1087 Flushing Ave., Brooklyn, N. Y.

HEDDLE AND STOP MOTION FOR LOOMS—Wherein the yarn may be threaded into the eye without disconnecting the heddle or the use of an instrument. Patent 1493390. H. Ruegg, Jr., Kingswood, Weehawken, N. J.

PLANING DEVICE—For use in connection with the surfacing of stone, rock, etc. Patent 1493380. W. H. B. Perry, Waterbury, Vermont.

SOCKET-ROD ELEVATOR—Capable of engagement and automatic latching connection with a socket rod. Patent 1492739. A. H. Neilson, 817 E. Admiral St., Tulsa, Okla.

APPARATUS FOR DISPOSING WATER IN FIREPROOF TANKS—Such as are constructed to hold inflammable liquids, by causing an even distribution of the water on the tank cover. Patent 1493344. W. S. Huff, 2113 W. Maple St., Stock Yard Station, Oklahoma City, Okla.

STONE SAWING MACHINE—For cutting granite, marble, stone or other material. Patent 1493379. W. H. B. Perry, Waterbury, Vermont.

PISTON HEAD FOR PUMPS—Which will maintain the washer forming the head, in engagement with the cylinder walls. Patent 1494243. S. C. Hills, 363 So. Main St., Torrington, Conn.

DRINK MIXER—Capable of giving a drink container a movement for thoroughly mixing the ingredients. Patent 1494246. S. S. Jerwan, 117 W. 8th St., Cincinnati, Ohio.

PISTON GRINDING JIG—For accurately holding the piston during the grinding operation. Patent 1494244. A. T. Hoagland, 54 Underhill Ave., Brooklyn, N. Y.

TYPE SETTING, PRINTING AND DISTRIBUTING MACHINE—In which a typewriter keyboard controls the setting, printing, and distributing means, for printing letters, or printed pages to be photoengraved for use as printing plates. Patent 1495014. J. Galloway, 70 Astor Place, Jersey City, N. J.

COIN-CONTROLLED VENDING MACHINE—In which only perfect coins will operate the mechanism, rejected coins being automatically returned. Patent 1495015. J. A. Garcia, c/o Sterling Engv. Co., 200 William St., New York, N. Y.

COMPENSATOR—For chart rollers, the difference in diameter of two rollers being automatically compensated for. Patent 1494611. R. M. McGrew, 2d and Utah Sts., Butte, Mont.

UNIVERSAL JOINT—Which will permit of maximum deflection in the angles of connected shaft sections. Patent 1494465. A. W. Dunn and G. Potter, 5540 Foothill Blvd., Oakland, Cal.

QUICK-CHANGE CHUCK AND COLLET—By means of which the collet may be shifted into the chuck with one hand. Patent 1494,859. F. P. Miller and S. H. Norton, c/o McCrosby Tool Co., Meadville, Pa.

BAND SAW SHARPENER AND SETTING MACHINE—Which can be placed in operative position with relation to the saw without removing the same from its frame. Patent 1494995. H. Craddock, Clinton Heights, Rensselaer, N. Y.

HYDROMOTOR—Wherein the wheel is so arranged that its blades are successively presented to flowing water causing rotation and driving power. Patent 1494528. J. W. Clanton and A. W. Blanchard, Box 895, Payette, Idaho.

PLATEN—For multigraph machines, or kindred machines, such as the multi-color press. Patent 1495013. D. O. Freeman, P. O. Box 114, Scranton, Pa.

POWER DEVICE—Whereby a plurality of motors may be supported in diametrically opposed relation and caused to travel about circular racks. Patent 1495930. A. W. Sing, 131 Main St., Tarrytown, N. Y.

DRILLING DEVICE — Whereby the drilling can be done in a narrow space, and at several speeds. Patent 1495885. C. Contal, 11 Rue de Milan, Seine Department, Paris, France.

WATER DRAWER—For use in automatically drawing water from beneath the oil, in oil containing tanks of refineries. Patent 1495,343. F. Montgomery, 904 7th St., Port Arthur, Texas.

TORPEDO-LOWERING HOOK—Especially adapted for use in lowering nitro-glycerin containing shells in oil or gas wells. Patent 1495557. M. M. Kinley, c/o Standard Torpedo Co., Tulsa, Okla.

AUTOMATIC TRAFFIC SIGNAL — Adapted for use in regulating street traffic without the services of an officer. Patent 1495571. S. P. Boshnyak, 915 2d Ave. N. E., Rochester, Minn.

VALVE—Which serves to efficiently control the flow of liquid through an orifice. Patent 1495223. M. Dobrin, 11415 Kensman Rd., Cleveland, Ohio.

PRINTING-PRESS ATTACHMENT — In the form of a yielding register fork for automatic feeding mechanism. Patent 1496656. J. H. Cunningham, 220 Anderson St., San Francisco, Cal.

AUTOMATIC VALVE CONTROL — Having means for closing the valve when a predetermined quantity of liquid has passed the same. Patent 1494746. G. C. Irons, 728 Obispo Ave., Long Beach, Cal.

ANCHOR FOR PUMP TUBES — For deep wells in which pumping means are utilized above the perforate lower portion receiving the fluid. Patent 1496161. W. Marsh, Bristol, W. Va.

PICKER CAM—Having means whereby the cam may be attached or removed from a loom in an easy manner. Patent 1496485. N. McC. Neal and G. W. Davis, Box 292, Aurora, Ill.

CLOCK—Which affords a clear and distinct indication of standard and daylight-saving time. Patent 1496348. R. C. McArthur, 33 Main St., c/o A. E. Krieger, Salamanca, N. Y.

BEARING—With means whereby a bearing casing is permitted to automatically adjust itself to deflections in the shaft. Patent 1496163. N. G. Miller, 513 Healey Bldg., Atlanta, Ga.

INTERMEDIATE CARRIER FOR CANE-SUGAR MILLS—For transferring the bagasse from one macerating mill to another. Patent 1497181. J. Meinecke, c/o W. S. Hill, Cotton Mill Co., Honolulu, Hawaii.

WALKING TAMPER—Having tamping members supported for automatic and mechanical downward and upward movement. Patent 1497594. D. L. Sauerhering, c/o W. W. Albers, 301 3d St., Wausau, Wis.

CARBONATOR—Adapted for use in connection with purifying the sugar extract in the manufacture of beet sugar. Patent 1497214. F. Kaspar, 203 Geneva St., Huntington Beach, Cal.

AUTOMATIC INTERLINING APPARATUS FOR TYPE SETTING AND CASTING MACHINES—Which permits the extraction or placement of a space-line or lead during composition. Patent 1497498. E. Garda, 68 Rue Reaumur, Paris, France.

WAVE MOTOR—In which a plurality of floats rising and falling with the waves impart rotary motion to a shaft. Patent 1497,205. C. F. Bossinger, 209 Brizzolara St., San Luis Obispo, Cal.

VALVE — Provided with a seating disk which gives a tight closure. Patent 1497473. F. W. Bartley, 2119 Lime St., Newberry, Williamsport, Pa.

TRANSPORTABLE TYPEWRITER—Which by special arrangement of the operating mechanism, reduces the height to a minimum. Patent 1497482. H. Burg, Mollkirch, Bas-Rhin Department, France.

CASTING BOX—For making high type cuts or plates. Patent 1498501. W. G. Wilkes, 505 Seal Ave., Biloxi, Mississippi.

OIL-WELL REAMER—Which may be easily lowered into the well or removed therefrom. Patent 1498463. J. P. McCloskey and H. R. Swan, 18 W. 34th St., New York, N. Y.

SEWER CLEANER—Adapted to be drawn through sewers or like conduits for ejecting material. Patent 1498446. M. C. Geskey, 312 Willard Ave., Lincoln, Ill.

Medical Device

THERMOMETER AND CASING THEREFOR—Which may be conveniently carried in the pocket of the user. Patent 1495100. C. Nurnberg, 260 E. 138th St., New York, N. Y.

Prime Movers and Their Accessories

CARBURETER—Capable of utilizing either fuel of a high grade, or of low grade. Patent 1495566. H. W. Allen, c/o R. J. Cross, Mayfield, Cal.

CHARGE FORMING DEVICE—Having means for supplying heated air to the charge taken into the intake manifold. Patent 1496711. L. R. Kierland, Rushford, Fillmore Co., Minn.

Railways and Their Accessories

GUARD FOR RAILROAD CROSSINGS — To prevent vehicles from reaching the tracks at highway crossings. Patent 1494540. G. W. Goodman, 51 No. Lauderdale St., Memphis, Tenn.

BRAKE FOR RAILROAD TRAINS — Particularly relating to the Westinghouse air brake equipment for locomotives. Patent 1496452. W. S. De Camp, 121 E. Water St., Chillicothe, Ohio.

STANDPIPE—For supplying either water or fuel oil to a locomotive. Patent 1496096. E. E. Mullins, c/o American Club, Prado Vertudes St., Havana, Cuba.

Pertaining to Recreation

AUTOMAGNETIC BOWLING ALLEY—Having means whereby the pins may be mechanically set up. Patent 1494285. L. G. Regnier, 1367 Plimpton Ave., Bronx, N. Y.

ROLLER SKATE—Designed more especially for the purposes of safety than for speed. Patent 1494210. T. Bosshard, St. Albans, Queens County, N. Y.

GOLF CLUB—In which the balance weight of a driver or brassie, is so constructed that it will maintain its original position. Patent 1497578. C. L. Mothersele, 116 Whiteford Ave., Nutley, N. J.

Pertaining to Vehicles

TRANSMISSION GEARING — Doing away with the necessity of a clutch as well as release of the clutch at each gear change. Patent 1496921. B. Campbell, Box 1467, Buena Vista Sta., Miami, Fla.

VEHICLE END GATE—Fastener which is simple and efficient for end gates or like swinging closures. Patent 1469793. C. J. Unger, 310 So. 3d St., Ironton, Ohio.

CIRCUIT BREAKER — Capable of various uses, but primarily intended for use in the ignition circuit of automobiles. Patent 1497582. A. Petersen, 830 Amsterdam Ave., New York, N. Y.

PNEUMATIC TIRE—Having compartments side by side for separate inner tubes, so that upon deflation of one tube the other will occupy the entire space. Patent 1497584. L. F. Petey, Rhinelander, Wis.

SPEED CONTROL PEDAL FOR MOTOR VEHICLES—Relating particularly to a control mechanism for the high and low speed pedal of Ford automobiles. Patent 1497612. G. C. Sweeny, 621 Ave. J, Brooklyn, N. Y.

SAFETY LAMP—For mounting on a vehicle to illuminate any portion of it, or the ground beneath. Patent 1498502. H. A. D. Baer, 1146 Hamilton St., Allentown, Pa.

FLAT-TIRE SIGNAL—The mechanical parts being actuated before the tire is actually flat. Patent 1498306. H. E. Shropshire, 219 E. Base Line, San Bernardino, Calif.

HEADLAMP WRENCH — Of the adjustable strap type which may be quickly applied. Patent 1496707. T. I. Gaw, 671 10th St., Brooklyn, N. Y.

The Stamp of Our Approval

A Jury of One

YOU are the judge and the jury. Your verdict is final. There can be no appeal—for this is the High Court of Public Opinion. The wares of the world must appear before you—the product of every factory—the merchandise of every store. Those things that fail to measure up to your requirements are quickly condemned to oblivion.

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LUBRICATING SYSTEM—For motor vehicles, adapted to control the flow of a lubricant by the flexure of a spring. Patent 1490818. P. H. Gaskins, 1207 Graham Bldg., Jacksonville, Fla.

TIRE-CHAIN HOOK—Which may be associated with various types of tire-chains and may be readily released. Patent 1491240. C. Johnston, Frankford, Missouri.

COLLAPSIBLE CORE—The inventor has been granted two patents for cores, the segmented sections of which are so constructed that they may be collapsed to a maximum degree, in separating the core from the tire. Patents 1491681 and 1491682. P. de Mattia, c/o Munn, Anderson & Munn, Woolworth Bldg., Broadway, New York, N. Y.

WHEEL PROTECTOR—In the form of a facing sheet of elastic material for one or both sides of an automobile wheel. Patent 1492438. F. Druckenmueller, c/o Fehlert Co., S.W. 61 Belle, Allianceplatz 17, Berlin, Germany.

AUTO STEP MAT—Which will clean the shoes and allow the dirt or snow to pass through the mat. Patent 1492527. O. L. Morsen, 335 Summer St., Akron, Ohio.

LOCK FOR MOTORS—Adapted to render inoperative the fuel and ignition supply, whereby the motor may be entirely shut off. Patent 1491889. J. McL. Taylor, Room 3403, Woolworth Bldg., Broadway, New York, N. Y.

TIRE-INFLATING DEVICE—In which explosions of the motor are employed to actuate the pump. Patent 1492203. N. M. Chubrich, 289 Tennessee Ave., Detroit, Mich.

LOCKING DEVICE FOR STEERING WHEELS—Which engages the spokes of any wheel of ordinary construction to prevent rotation. Patent 1492645. R. B. Lillard, 412 So. Lucas St., Los Angeles, Calif.

SHOCK ABSORBER—Of the cushioning type adapted for positioning between the frame and axle. Patent 1492731. B. Kerr, 371 Cromwell St., Ontario, Canada.

DEMOUNTABLE RIM—With means for facilitating the operation of securing the rim on the wheel and for removing the same. Patent 1492835. C. E. Crownover, Route 6, Yakima, Wash.

AUTOMOBILE LOCK—Adaptable to be interposed between the carbureter and the combustion chamber, to prevent operation of the engine. Patent 1493336. G. Glenn, R. F. D. No. 1, Butte, Mont.

SPRING SUSPENSION—More particularly for supporting the forward end of a vehicle body from the axle. Patent 1494281. V. W. Page, c/o Victor Page Motor Co., Melrose Ave., Stamford, Conn.

LOCK FOR AUTOMOBILES—Adapted for locking the brake and clutch pedals in an inoperative position. Patent 1494219. C. Cynamon, 2355 Southern Blvd., Bronx, N. Y.

DIRIGIBLE HEADLIGHT—Effecting the turning of the lights simultaneously with the turning of the vehicle. Patent 1495111. C. G. Roescher, 64 Winthrop St., New Britain, Conn.

COMPOSITION OF MATTER FOR MOTOR FUEL—Which comprises gasoline, naphtha, benzine, kerosene and ten per cent cresol. Patent 1495005. W. G. Dunning, Box 26, Westtown, Pa.

SIGNAL FOR AUTOMOBILES—Operated to indicate the driver's intention to turn either to the right or left. Patent 1494359. S. Kahn, G. Gallegos and S. A. Connell, 109 No. 1st St., Albuquerque, N. M.

HEADLIGHT—Which will project light rays on the road but prevent glare to those approaching. Patent 1494550. W. B. Johnson, 112 Warren St., Lexington, Ky.

VEHICLE FENDER—Which will not detract from the appearance of an automobile, and may be manually operated from the driver's seat. Patent 1495835. C. Arcidiacono, 426 E. 76th St., New York, N. Y.

FAN BELT AND PULLEY CONSTRUCTION—Designed for use in connection with cooling fans for Ford motors. Patent 1495878. R. Bohm, 311 Park St., Richmond Hill, L. I., N. Y.

DISTRIBUTING APPARATUS—Whereby pulverized material, such as fine sand, may be scattered before the drive wheels of a motor vehicle. Patent 1495381. P. W. Carney, 417 Fairfax Ave., Norfolk, Va.

WHEEL BRACE—Which may be applied to the ordinary type of wagon or vehicle wheel, without special tools. Patent 1496170. A. Renner, Madison, Neb.

AUTOMATIC INFLATING VALVE AND PRESSURE GAGE—Enabling the operator to gage the pressure within a vehicle tire while standing in an erect and comfortable position. Patent 1495679. W. R. Donaldson, 1629 Brookes Ave., San Diego, Cal.

TIRE COVER—Which may be applied or removed without the removal of nuts or other fastenings. Patent 1495665. E. E. Bigelow and P. Thompson, 366 Willow Ave., Pontiac, Mich.

VEHICLE WHEEL—Having an annular series of balls disposed within the rim, and built against slipping. Patent 1496225. C. A. Lagrave, 925 10th St., Sacramento, Cal.

STARTING DEVICE FOR AUTOMOBILES—Providing a positive engagement with the flywheel without clash, and an automatic release when the engine starts. Patent 1492918. A. M. Burgher, 623 Carlisle Ave., Dayton, Ohio.

LIFTING JACK FOR MOTOR VEHICLES—In which the motive power of the vehicle is utilized for elevating one or more of the wheels. Patent 1498036. A. L. Holton, Big Stone Gap, Va.

Designs

DESIGN FOR A TRAY—Patent 64070. M. Levine, 635 E. 9th St., New York, N. Y.

DESIGN FOR DRESSES—Patents 64105 and 64106. E. E. Wolf, 148 W. 37th St., New York, N. Y.

DESIGN FOR A DOLL—Patents 64118 and 64117. Clara V. Havens, c/o The Karmen Corp., 212 E. 23d St., New York, N. Y.

DESIGN FOR A LAMP—Patent 64199. U. S. Page and J. C. Page, c/o Miller, 28 W. 132d St., New York, N. Y.

DESIGN FOR A WALL LIGHTING FIXTURE—Patent 64197. H. J. D. Monteith, 141 East State St., Trenton, N. J.

DESIGN FOR A RING—Patent 64216. J. A. Sworbell, c/o Breslausky Bros., 67 Fulton St., New York, N. Y.

DESIGN FOR A CHAIR SEAT—Patent 63883. C. Daum, c/o Am. Fibre Chair Seat Co., Long Island City, N. Y.

DESIGN FOR A LIP-STICK HOLDER—Patents 64249 and 64250. S. A. Jaroslawski-Fioret, c/o Fioret, Inc., 677 5th Ave., New York, N. Y.

DESIGN FOR A BADGE OR SIMILAR ARTICLE—Patent 64254. E. R. Locke, 2022 E. 89th St., Cleveland, Ohio.

DESIGN FOR A TEXTILE FABRIC—Patent 64255. C. E. Lord, 25 Madison Ave., New York, N. Y.

DESIGN FOR A PHONOGRAPH CABINET—Patent 64330. J. Zitzerman, 449 Stone Ave., Brooklyn, N. Y.

DESIGN FOR A COMBINATION CEDAR CHEST AND SETTEE—Patent 64348. R. Folsom, 525 Main St., Pendleton, Ore.

DESIGN FOR A LADY'S BLOUSE—Patent 64380. E. E. Wolf, Colony Club Frocks, 148 W. 37th St., New York, N. Y.

DESIGN FOR LEATHER OR SIMILAR ARTICLE OF MANUFACTURE—Patents 64358 and 64359. F. A. Kolb, c/o Geisman, Mustmer & Brightman, 27 Spruce St., New York, N. Y.

DESIGN FOR A TEXTILE FABRIC—Patents 64337 and 64338. Matilee I. Bixby, c/o Lowenstein & Sons, 40 West 23d St., New York, N. Y.

DESIGN FOR A PRINTED FABRIC—Patent 64339. L. Bluhm, 877 Broadway, New York, N. Y.

DESIGN FOR A COMBINED LAMP STAND AND INCENSE BURNER—Patent 64381. G. Yoshida, c/o Ginnwosuke Makayama, 1261 Broadway, New York, N. Y.

DESIGN FOR A TOY ANIMAL—Patent 64,465. Edith E. Levett, 507 W. 186th St., New York, N. Y.

DESIGN FOR A GLOBE FOR A SOAP-DISPENSING DEVICE—Patent 64477. L. B. Schwarcz, 1245 Madison Ave., New York, N. Y.

DESIGN FOR A SERVICE PLATE OR LIKE ARTICLE—Patents 64602 and 64603. J. H. Price, c/o Edward Boote, 35 W. 23d St., New York, N. Y.

DESIGN FOR A GOOD LUCK MARRIAGE CERTIFICATE—Patent 64636. M. Marcus, c/o Benjamin Marcus, 300 Madison Ave., New York, N. Y.

DESIGN FOR A CEILING LANTERN—Patent 64682. E. Ostrow, 3475 3rd Ave., New York, N. Y.

DESIGN FOR A BELT BUCKLE—Patent 64,754. M. Kline, 3 W. 29th St., New York, N. Y.

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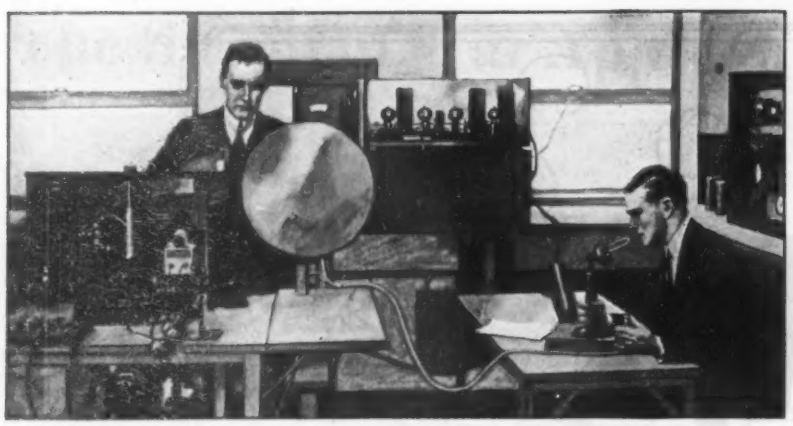

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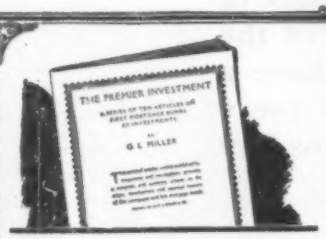

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A review of the technical and trade press, consisting of abstracts from leading articles announcing the newest developments in industry and engineering

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Automotive

Homebrewed Air Flivvers.—The composite specifications which may fairly well describe the mosquito fleet which will swarm to Dayton in October, for the contests will be about as follows: Span, 30 feet; length over all, 18 feet; height, 5 feet (monoplanes); 7 feet (biplanes); weight—empty, 300 pounds; loaded, 500 pounds; horsepower, 15-20; weight per horsepower, 25 pounds; wing area, 160 square feet; weight per square foot, 3.25 pounds. These planes should be able to land at 25 to 30 miles an hour, and will show a maximum speed of 60 to 70 miles. In the meantime design and construction of these homebrewed machines goes merrily on, in barns and cellars, maybe even kitchenettes. One enthusiast in Washington is building his plane in a lawn mower shop.—*U. S. Air Services.*

Cylinder Honing.—Honing as a process for finishing cylinder bores has come into extensive use among automobile and engine builders, and several of the leading companies that are at present finish-grinding their cylinders are known to be studying the possibilities of the newer process. Some uncertainty as to the distinction between honing and lapping seems to exist among engineers, but in general the former term is correctly applied to the use of stones as abrasives, while the latter is understood to involve the use of a lap or carrier charged with an abrasive. Precision of dimensions, closeness of fit, and the polishing of the surfaces may be considered the objectives of both processes. A recent survey of cylinder-finishing methods made by the research department of the Society of Automotive Engineers, as published in the society's *Journal*, included 24 of the well-known builders of automobiles and engines. Twelve of these hone the cylinders, nine finish-grind them, while the remaining three use the lapping process.—*Machinery.*

The Greatest Secrecy has been maintained concerning the work on the application of the semi-Diesel principle to aero engines, in England. The question of weight was naturally a serious one, but already the designers of the new engine have advanced so far that it is possible to state that an engine can be built which is not prohibitively heavy. The advantages which may be expected from an engine working on the Diesel or semi-Diesel principle may be briefly summed up as follows: Greater reliability, better fuel economy, and the possibility of employing a fuel considerably cheaper than petrol. It also appears likely that the risk of fire should be smaller by employing a fuel with much higher flash point, so that, altogether, the development of a semi-Diesel aero engine may well have the most far-reaching effects upon the future of commercial aviation.—*Flight.*

Inverting the Liberty Engine.—The Engineering Division of the U. S. Air Service has conducted successful tests with an inverted Liberty engine over the period of a year. In view of the success of this equipment, plans have been made to build four Liberty engines, especially designed for the inverted position and should these prove successful, it is possible that the inverted engine will be adopted as standard for all corps observation and pursuit type airplanes. The chief difficulty which confronted the engineers was the lubrication system. In addition to a number of changes in this, the flow of water through the water jackets was reversed, primarily to facilitate the operation of the water piping installation. According to the tests it would seem that this reversal makes for better operation of the engine, although this fact has not yet been fully proved in flight. No difficulty was found with spark plugs fouling, due to the change in the position of the cylinders. The reason for all this inverting of engines? The greatest advantage, and it is no insignificant one, is the decided reduction of the blind area straight ahead, which is typical of the DH equipped with the Liberty. This improved visibility simplifies the landing problem to a very marked degree and it is of great benefit in maneuvering. Another great advantage lies in the possibility of a simplified fuel system. Since the carburetor is hung under the engine, the fuel supply could be by gravity, obviating the necessity for fuel pumps. The accessibility of the engine for working is also greatly improved as the mechanic can accomplish most of it standing on the ground.—*Automotive Ind.*

Elliptical "Cylinders" for Motor Cars.—Considerable interest has been aroused by the description in *The Autocar* of some interesting experimental work on elliptical cylinders. Although the idea has previously been put forward it has met with a certain amount of scepticism. A standard 550-c.c. motor cycle engine was converted for the experimental work, and the flat-sided cylinder was arranged with side-by-side valves located along one of the flat sides, the major axis of the cylinder being in line with the machine. The length of the major axis is 4⅞ inches, and the ends of the cylinder have a one-inch radius, so that across the flats the cylinder measures two inches. In order to permit the bore of the cylinder to be machined, a detachable head was employed, and the experimental cylinder was bored by a rather complicated process, although if adopted commercially it would be formed by a process known as drifting. By the use of elliptical cylinders it will be possible to reduce the crankshaft length and distinct advantages are offered when overhead valves are employed, as it would be possible to utilize valves of larger diameter for the capacity of the cylinder without increasing the size of the head or pocketing part of the diameter of the valve.—(See *Autocar*, No. 1493.)

A Real Nut to Crack.—One of the Paris taxicab companies had an equally puzzling experience after fitting brakes on the four wheels. Crankshafts were found to be eaten away by rust, and it was weeks before it was discovered that, under the action of the brakes, water formed a head in the radiator and was discharged through the overflow on to the front end of the crank case. At least a quart of water was lost per day in this manner, but the loss would not have been serious had the water not been splashed on to the front end of the shaft, where a spiral designed to prevent oil passing out drew the water into the engine. A special radiator overflow which will prevent this leakage when the car is pulled up suddenly is now being made use of.—*The Autocar.*

Participants in the Strenuous Struggle to the Klondike in the late 90's may heave a sigh when they learn how simple getting past White Horse Rapids would have been with an airplane. The inauguration of a passenger and freight service by air to serve the new gold mining district of northwestern Quebec is an event whose full significance is not easy to grasp. The fare is forty dollars. The principal difficulty in exploring and opening up the north country of Canada is transportation. From the time the first explorer enters a mineral-bearing region until mines are established and a railway is constructed, most of the human energy expended is used up in transporting food and supplies to the scene of action. Freighting by airplane in winter offers another interesting prospect that may be of decided advantage to prospectors and mine operators in isolated localities. There is available now a machine, not adapted for use with floats, that has proved to be excellently adapted for use on snow with skids. The frozen lakes provide perfect landing places for this machine. Its rated capacity is three-quarters of a ton, and it will carry conveniently a ton or more. It has been calculated that, with steady operation, this

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machine will deliver supplies, at a distance of say, 50 miles, at a cost less than that of teaming over the winter roads.—*Can. Mining Jour.*

Civil Engineering

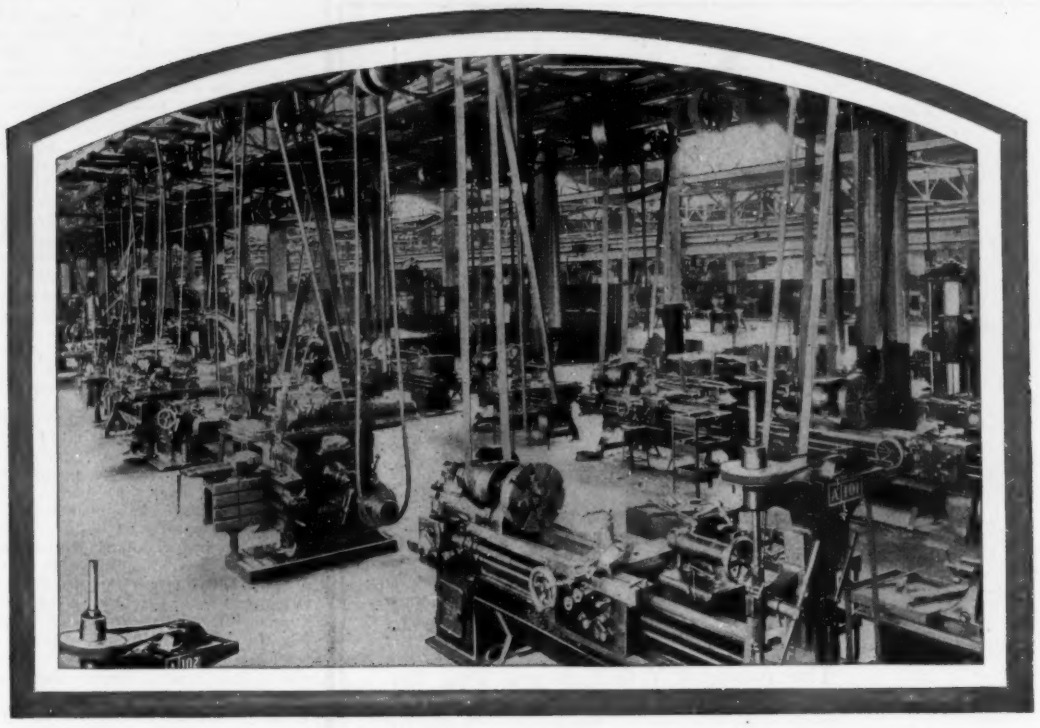
Rubber Paving.—Boston, Mass., became the first large American city to try out rubber pavements when quite recently the first rubber pavement for street purposes in America was laid on a bridge in the commercial district. Although trials in England antedated it by many years, this first experiment in this country was conducted with paving blocks of American invention and manufacture. Two sections, each 18 feet square, were laid, one on May 7 in the roadway devoted to horse-drawn vans and the other on May 14 in the motor roadway in the center of the bridge, a total of nearly 650 square feet. The paving is in blocks six by twelve inches and one inch thick. It is specially compounded of about one-third new rubber and two-thirds reclaim, and in vulcanizing the blocks are subjected to 333 degrees heat and 2500 pounds pressure. As the horses and vehicles pass over the rubber paved section, the lack of noise is at once noticed, thus showing the desirability of this class of pavement for bridges and quiet zones in streets around hospitals and other institutions, particularly residences and high-class office buildings. Although rubber pavement costs about three times as much as wood block, it is claimed by those who have studied its qualities that it will last many times as long, probably 20 years or more, and in the long run prove a saving to the taxpayers of the city. Rubber pavement laid in the courtyard of the St. Pancras Station in London, England, in 1870, is still down, and has worn down only 3/16-inch in 50 years.—*Ind. Rub. World*, 70:3, 2 pp., ill.

Why Railway Superintendents Grow Gray.—Value of a modern locomotive, $60,000. Interest, depreciation and taxes on one locomotive figure out for each productive locomotive hour, $2.47. Daily cost of maintenance, $13.10. Average productive time, only eight hours. Repairs, 2.4 hours. Unproductive time in engine-house, 13.6 hours. It is less expensive to own a flivver.—*Railway Age.*

Will Railway Rails Be Longer?—The recent action of the Southern Pacific in ordering more than 131,000 tons of rails to be rolled in 39-foot lengths has given impetus to the agitation for rails longer than the present standard of 33 feet. A few years ago certain mills agreed to roll small percentages of the orders from several roads in 39-foot lengths without extra cost, but this concession was withdrawn and of late the roads have been able to secure longer rails only by the payment of a premium, which premium has tended to discourage this action. The action of the Southern Pacific in distributing its large order among those mills which were able and willing to roll rails to this length without additional cost has now brought this matter to a head. It is said that the rail committee of the American Railway Engineering Association has not as yet been able to secure agreement between the proponents of 39-foot and 45-foot lengths.—*Railway Age.*

"Gas-Concrete."—A light concrete susceptible of sawing, planing and nailing has been developed by Axel Eriksson, a Swedish architect. It is made with cement and shale lime, together with a small addition of aluminum or zinc powder, which upon tempering the mass with water develops hydrogen in contact with the lime hydrate. This makes the mortar porous, in which condition it sets. With a mortar containing 40 parts of cement to 60 parts by weight of the lime, at 75 per cent porosity, the concrete weighs 40 to 50 pounds per cubic foot, and attains a compressive strength of 350 to 400 pounds per square inch after six weeks. The material is resistant to weathering and fire attack in satisfactory degree for use in wall masonry (except chimneys). The building authorities of Stockholm have approved the material for use in walls of one- and two-story dwellings in thicknesses of six to eight inches, at working stress not exceeding 43 pounds per square inch.—*Eng. News Rec.*

One of the Interesting Features of San Bernardino Shops of the Santa Fé System is the "slip-track" on which engines that have been overhauled are broken in and tested. The old and usual way was to run them over a division slowly and watch for defects. But sometimes conditions arose which made it necessary to speed up to get out of the way of regular trains. This



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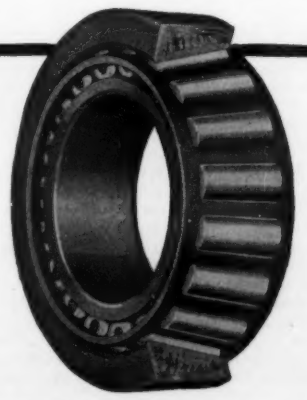

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frequently meant heating bearings somewhere, and occasionally some damage was done before the locomotive could be stopped at a junction and run on a siding. The "slip-track" is just what the name implies. A track on which the locomotive is allowed to run just as in service, but on which it slips freely, although it allows the locomotive to run just as in actual service for perhaps a mile, including the reverse curve so as to give the locomotive side motion and test out the hub liners and thrust plates. The locomotive to be tested is provided with pipes that flow oil on to the track under the drivers so that they slip quite freely, allowing a high rotative engine speed if desired, with a slow forward movement. This test develops all the rattles, pounds and slaps possible, and makes it easy to locate each defect. Then, too, if heating develops at any point, it can be quickly detected without fear of getting in the way of a regular train.—*Amer. Machinist.*

The Proposed Louisiana and Texas Canal, from New Orleans to Corpus Christi, is now being surveyed by the army engineers on the basis of a single unit. The surveys now being conducted are seeking the construction of a coastal waterway of dimensions to make it a part of the inland waterway system of the Mississippi river and its tributaries. There is now existing a canal system from the Mississippi at New Orleans to the Sabine river at Orange, Texas, with a similar stretch from Galveston to Corpus Christi. Both of these stretches were constructed by sections, which the present surveys would overcome. The depth of these stretches is five feet, with 40 feet of bottom width. The canal proposed would have depth of nine feet and bottom width of 100 feet. The cost of the canal as now proposed will be in excess of $10,000,000 with $12,000,000 as the maximum. This cost does not include the extension of the canal system to Brownsville, Texas, the ultimate goal of the coastal inland waterway in the plans of the organization backing its construction. — *Manufacturer's Record*, 84:15, pp. 87-89.

Electrical

If An Untreated Pole rots off at the ground line but the upper part remains in good condition, how much additional life can be obtained by cutting off the rotted end and resetting the shortened pole? Presumably the wood above the ground line has been untouched by decay and is still as strong and durable as ever, but is this actually the case? Although this is a practical question which has been put to the Forest Products Laboratory a number of times, no service records or experimental data were available upon which to base an answer. A questionnaire which was sent out resulted in the compilation of the following information: In rotting off the original pole at the ground line the fungus may extend some threads considerably above the ground line. The threads would make very little progress in rotting the pole at that level because of insufficient moisture, but they would be in excellent position for rapid development and extension whenever moisture conditions became more favorable. Cutting off the butt and resetting the pole would provide the favorable conditions. Moreover, in many cases the extent of primary deterioration is no doubt much greater than casual examination might lead one to believe. When the reset pole is dropped into the hole it is consigned to a veritable hotbed of infection. The natural chemicals of cedar and other durable woods which help them to withstand decay may leach out or volatilize to some extent during the long exposure before the pole is reset, thus leaving the wood of the reset pole less resistant to the wood-destroying fungi. Early removal of the reset pole may in some cases be due to its having been cut too short, so that adding another cross-arm or making other changes or improvements in the line may render it obsolete before it has been destroyed by decay. The average added life was believed to be about eight years or a little over.—*Elec. World.*

Transformer Development during recent years has involved the production of self-cooled transformers in some very large sizes. Water for cooling is frequently expensive, or hard to get, or needs to be recooled by cooling tower, spray pond or the like and in cold climates there is always a possibility of freezing of the circulating system. Space requirement and general bulkiness, proportions of investment represented by the radiators and their contained oil, and possible fire hazard through the presence of large quantities of oil in the tank and radiators are beginning to lead towards research into other methods of cooling, notably circulating oil through radiators of the automobile type, air being blown through these radiators by auxiliary power driven blowers or fans. An unusual method of transformer cooling is used by the Southern California Edison Company at one of its substations, located in a congested part of the city where ground space is at a premium. The building is several stories high and the transformers are located in the basement, but the radiators used for cooling are on the roof so that advantage may be taken of the breeze blowing from the ocean. This station has been in operation for several months and the method of transformer cooling has been sufficiently satisfactory to justify the installation of another transformer bank, using the same method of cooling.—*Power Plant Eng.*

An Electromagnetic Dry Separating Process, which it is claimed is capable of recovering coke and unburned coal from ashes from industrial firing, has been introduced by the Friedrich Krupp Company, according to a report forwarded to the Department of Commerce by W. T. Daugherty, assistant trade commissioner at Berlin. The process is based on the fact that hard-coal slag responds to attraction in a highly concentrated magnetic field, while coal and coke do not. This difference of behavior in the magnetic field is explained by the fact that when the coal is burned, even if it is finely ground, the iron-containing unmagnetic materials are transformed to magnetic iron compounds which go over into the slag, making it responsive to magnetic attraction. Many different experiments which the Krupp concern tried with different sorts of coal have shown that a 30 per cent weight of coal ashes is recoverable as coke and coal. In many cases it was found that 50 per cent weight was fuel, and in some cases even more. The process is recommended by the Krupp concern to all consumers of coal. The ashes are fed to the magnetic drum from a shaker screen or sieve. The separation of the slag from coke and coal occurs on the drum in such a manner that the slag is attracted by the powerful magnetic force and held fast on the revolving drum, until it emerges from the magnetic field after a half-revolution and is thus thrown off, while coal and coke are thrown off previously.—*Elec. World.*

Two New and Interesting Modifications of the Electrostatic principle, for direct-reading voltmeters up to 250 kv., have recently been announced; and for each of these there is claimed permanent calibration independent of surrounding objects and for either of the conditions—one terminal grounded or both terminals insulated. In each the indicating instrument is the usual type of quadrant electrostatic voltmeter, with a carefully screened air condenser which takes up the greater part of the total potential difference. In the first, by A. Imhof, described in a recent number of the *Bulletin Schweizerischer Elektrotechnischer Verein*, a cylindrical air condenser is completely inclosed in an outside metallic housing, and connection is made between the outer member of this cylindrical condenser and the recording instrument on the outside, through a suitable insulating bushing. Of somewhat greater interest is the instrument of K. A. Sterzel, described in *Elektrotechnische Zeitschrift* for February 14th. In this case the recording instrument is completely inclosed in a metal sphere and its pointer projects through a narrow slit, working over a horizontal scale marked on the surface of the sphere. This sphere is placed concentrically between two outer concave spherical surfaces forming the two terminals of the instrument. Similar circular disks at opposite ends of a diameter are cut in the surface of the inner sphere and insulated therefrom. These form the terminals on the inclosed recording instrument. The capacity between these disks and the outer spherical members is apparently free from outside disturbance when the angular embrace of each outer concave electrode is 90 degrees. The size of the meters is the most objectionable feature.—*Elec. World.*

General

When is An Inch Not An Inch?—This question was discussed at a recent meeting of United States Chamber of Commerce with Secretary Hoover, "How thick should a one-inch board be?" This is no joke, as anyone engaged in building from specifications will testify. Thirty-two different thicknesses

(Continued on page 198)

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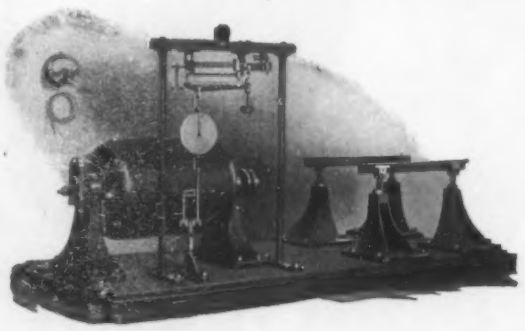
—insure Accuracy in Dynamometers



IN no machine are bearing requirements more exacting than in a dynamometer. Inaccuracy is fatal—friction would vitiate readings—no catch or hitch would do—that is why the Sprague Works of The General Electric Company use Gurney Ball Bearings.

Let our bearings help eliminate any difficulties you are now having with other types of bearings. Our engineering department is at your service.

Marlin-Rockwell Corp. **JAMESTOWN, N. Y.**

18252

Scientific American Digest

(*Continued from page 196*)

of one-inch board are in current use. This condition unnecessarily complicates matters and it is with a view of eliminating this complication that a single standard in this respect has been suggested.—*Power Plant Eng.*

The General Idea of an Astronomer's Work, as gathered from the questions and remarks of visitors, is that he sits at the eyepiece of the telescope sweeping the heavens in a search for new planets, comets, or stars. The absolute futility of such a use of the telescope is evident when it is realized that the main field of the 72-inch telescope of the Canadian Dominion Astrophysical Observatory covers only about one hundredth-millionth of the sky, and if only five seconds was required to examine each field it would take more than a lifetime to go over the whole sky once. A second misconception is the idea that large telescopes are used for visual observations of the planets with special reference to their habitability. No work is being attempted at this or other large observatories on planetary detail for which about an 18-inch refractor gives the best results and such a large telescope as the 72-inch is quite unsuited. All scientific observations with the 72-inch are made photographically and it is only arranged for visual use on Saturday evenings when for two hours visitors are allowed to observe the heavenly bodies. A third misconception is that the astronomer only works at night. However true this idea may have been in the days of visual observations when the measurements were made at the eyepiece, there is certainly now, when photography is so generally applied, more day than night work in astronomy. Besides the advantages of permanency, accuracy of measurement, and power of recording objects beyond the range of the keenest eyesight, the photographic method has the further great advantage that an hour's exposure may give sufficient material for several days' measurement and discussion.—*English Mech.*

Rats vs. Rubber.—A firm in Singapore has concocted and put on the market a rubber compound which when softened by heat and spread on a board will like birdlime snare the unwary bird, beast or insect which may cross the too hospitable threshold. Rats and mice stick to it closer than a brother, and the trouble is not so much getting them on to it as getting them off again.—*Jour. Roy. Soc. Arts.*

Try This Over on Your Argumentative Acquaintances. — Attention has been called recently to the difference in the weight and the displacement of a ship steaming east and one steaming west on account of the centrifugal force acting upon it. A specific example is cited of an American 1100-ton destroyer traveling westward at 25 knots and adding 262.8 pounds to her weight, while the same craft speeding eastward would substract 480.628 pounds from her weight. *The Engineer*, London, has taken pains to look into the matter and gives us some additional facts. Inasmuch as a vessel running at 25 knots has a speed of 42 feet per second, and as the peripheral speed of the earth at the equator is 1560 feet per second, it is clear that in steaming westward, with the two speeds opposing each other, the true linear velocity of the ship would be 1518 feet per second, while on an eastward course it would be 1602 feet. The centrifugal force exerted on a vessel of the aforesaid size and speed is 8410 pounds on a westward course and 9366 pounds on an eastward journey—indicating a difference of 956 pounds between the two conditions.—*Comp. Air Mag.*

To the Farmer, dodder is no joke. It is a parasitic weed that twines around the stalks of respectable plants and gets its living from them. It often becomes so widespread as to cause serious inconvenience as well as considerable loss to the farmer. In clover, especially, its eradiction has presented a most serious problem. Seeds of the two plants become mixed; and, being quite small and similar in size, it has hitherto been impossible to throw out the intruder. Nevertheless, the trick is now being done, and one would never guess how. When we say that an electro-magnet does it, the mystery only deepens; but the explanation is very simple. A quantity of very fine iron filings is sifted upon and stirred into the mixture to be separated, and the mass is moistened. The wet clover seed remains smooth and clean, but the dodder develops a sticky substance to which the iron dust clings. Then the seed is poured in a thin, flat stream in front of a powerful electro-magnet without actually coming in contact with it. But even so the pull of the magnet is sufficient to draw the iron-coated seeds slightly out of their vertical course and away from the clean clover seeds, so that the latter drop straight down while the former are carried a little to one side and deposited in a separate receptacle—and there you are.—*Comp. Air Mag.*

England's Mystery Towers—Gone But Still Mysterious.—No more interesting or notable demolition job has been undertaken in recent years than the cutting down of the "mystery tower" in Shoreham Harbor. One of the two towers, built during the World War, was towed to a position about five miles east of the Isle of Wight to replace Nab Lightship, while the other was cut down by oxy-acetylene torches and compressed-air tools. These towers—begun by the Admiralty in 1918 for a purpose which has never been disclosed and which has greatly exercised the imagination of the public—were constructed on rather unusual lines that closely corresponded to those of a honeycomb. The steel superstructure was cut down by oxy-acetylene torches, and the reinforced concrete was broken up by means of pneumatic tools. To the layman, the tearing down of this structure might seem a simple matter, but such was not the case. The concrete proved to be exceptionally tenacious; and, piece by piece, it was necessary to cut entirely through both the cement and the metal all the way round in order to wreck the tower. Altogether, about seventeen miles of cuts had to be made in the floors and the cell walls, and all this work was done by compressed air equipment.—*Comp. Air Mag.*

Fuel Revolution in New York City.—Up to December, 1919, the burning of fuel oil was unknown in New York, while today the practice is so extensive and gaining so steadily in favor that it is impossible for us to enumerate examples with any satisfactory detail. We can mention only the large hotels, the department stores, and the big office buildings. One of the first of the hotels to adopt oil for fuel, so we learn from *Oildom Daily*, was the Ritz-Carlton, whose plant has been in operation for two years. During the first six months, the system saved the management in fuel, $17,000; in labor, $5424; in ash removal, $2388; and in repairs, $678—a total of $25,490. Similar systems have now been installed in more than a dozen of the other large New York hotels. The same story can be told of the department stores in the shopping district, of the big department houses uptown, and to a greater extent of the modern skyscraper office buildings throughout the business sections of the city. The Equitable building, using about 10,000 gallons a day, has a five-year contract for oil at 4½ cents a gallon.—*Comp. Air Mag.*

Finishing a Large Telescope Lens or Mirror is such a nerve-wracking task that the experts who do the infinitely painstaking work sometimes suffer injury to their health and nerves. *The Journal of the Royal Astronomical Society of Canada* (18:5) contains an appreciation of James B. McDowell, who worked day and night on a 26-inch objective, followed by a 27-inch objective and after working to a very late hour often rested on a convenient couch. There he was found dead. There is no doubt, says a writer in the *Journal*, that he was the first optician of his time. The final work consisted in bringing the whole area of 4000 square inches to an accuracy of about an eighth of a wave length of light, one four-hundred-thousandth of an inch. The nervous tension which such exacting work induced in Mr. McDowell and his able chief assistant Mr. Fred Hageman, even also on Dr. Brashear and the writer, was shown by their inability to rest, think of anything else, or do any other work in the long waits of several hours required for the mirror to steady down before a reliable test of the result of half an hour's polishing could be made. The intervals after polishing were spent in futile testing or attempts to pass the time by solitaire or other card games. The disappointment, when after all the care, anxiety and nervous strain, the mirror was finally in a smoothing process polished too deep in the center, was so great as to make Mr. McDowell actually ill. It is certain that the great nervous strain, which these large optical surfaces entailed, undermined his health, robust as it was, and the tension of the figuring of the 26-inch Yale, closely followed by the 27-inch Ann Arbor, was too much for even his strength, and he died suddenly in the shop on November 28th last.

(*Continued on page 200*)

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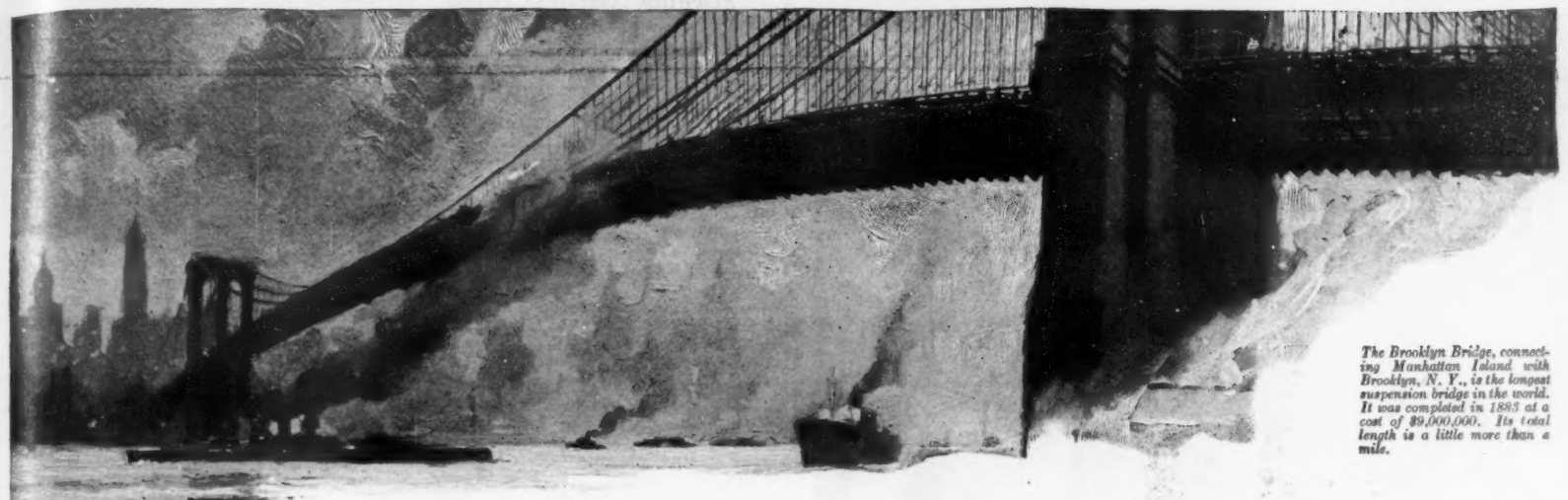


The Brooklyn Bridge, connecting Manhattan Island with Brooklyn, N. Y., is the longest suspension bridge in the world. It was completed in 1883 at a cost of $9,000,000. Its total length is a little more than a mile.

Where lead is a shield for steel

STREAKS of red stand out against the sky. Tiny figures suspended in mid-air cover the steel cables of the bridge with red-lead.

The engineer correctly estimates the stresses and the strains on such a structure. He specifies steel of the proper tensile strength and dimensions for it. But from the time the bridge is built, rust seeks to destroy it.

Lead is the shield that protects the steel cables, girders, and beams from rust and prevents the bridge from becoming a death-trap. It keeps the bridge strong today, strong tomorrow, and for years to come.

This is only one of the many ways in which lead constantly serves you and guards your safety. You do not always see lead in use. But as red-lead in paint you see it on metal surfaces everywhere. Red-lead is the standard protection for iron and steel. It is used in its natural orange-red color or tinted to dark colors.

Nearly twenty million pounds of red-lead are applied to metal every year in this country. Yet this is not enough. Rust still destroys millions of tons of steel. Between 1860 and 1920 the world's output of iron and steel was about 1,860,000,000 tons. Of this total it was estimated that 660,000,000 tons were wasted through rusting in use. Just as unpainted houses decay and crumble, so iron and steel, unprotected by paint, rust and are soon ready for the scrap-heap.

Where red-lead saves metal

Wherever iron and steel are, there red-lead is needed to save the surface. Special care should be taken to cover with red-lead iron and steel that becomes inaccessible for painting after erection.

Railroads in the United States use red-lead to protect their bridges, steel rolling stock and steel structures. Gas and water companies put red-lead on stand pipes, tanks and gasometers. They have found from experience that red-lead protection lowers the cost of maintaining iron and steel structures.

In ships of the United States Navy and on vessels of all types, red-lead

This painter is risking his life to give the steel cables of the Brooklyn Bridge paint protection. He is putting on red-lead, the strongest shield that steel can have against rust.

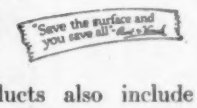
guards hulls, cargo holds, coal bunkers, chain lockers—all metal parts of a vessel—from deterioration due to exposure to salt and fresh water and varying atmospheric conditions.

Red-lead keeps rust from attacking metal roofs, steam radiators, registers, pipes, fire escapes, fences, iron gates and exterior ornamental work of all kinds. It covers machinery, trucks, iron pipes, and metal equipment.

Red-lead has been used for generations as the standard protective covering for metal. Mixed with pure linseed oil, pure red-lead makes a paint that dries to a hard, tough layer and clings tightly to the surface. It is insoluble in water.

Red-lead should be and is usually used next to the metal in its natural orange-red color. It is tinted to dark colors for finishing coats for the sake of appearance or for inspection purposes.

Dutch Boy red-lead is the name of the pure red-lead made and sold by National Lead Company. On every keg of *Dutch Boy red-lead* is reproduced the picture of the Dutch Boy Painter shown below. This well-known trade mark guarantees a product of the highest quality.



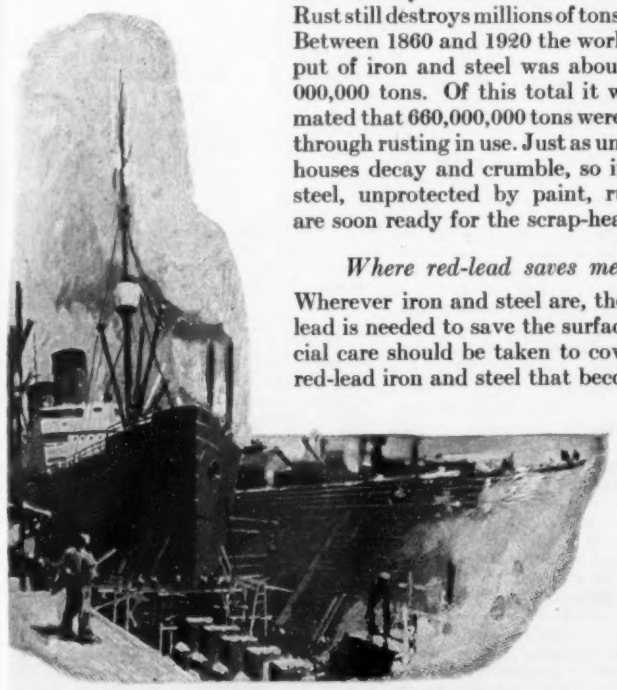
Dutch Boy products also include white-lead, linseed oil, flatting oil, babbitt metals and solder.

National Lead Company also makes lead products for practically every purpose to which lead can be put in art, industry and daily life. If you want information regarding any particular use of lead, write to us.

Further information about lead

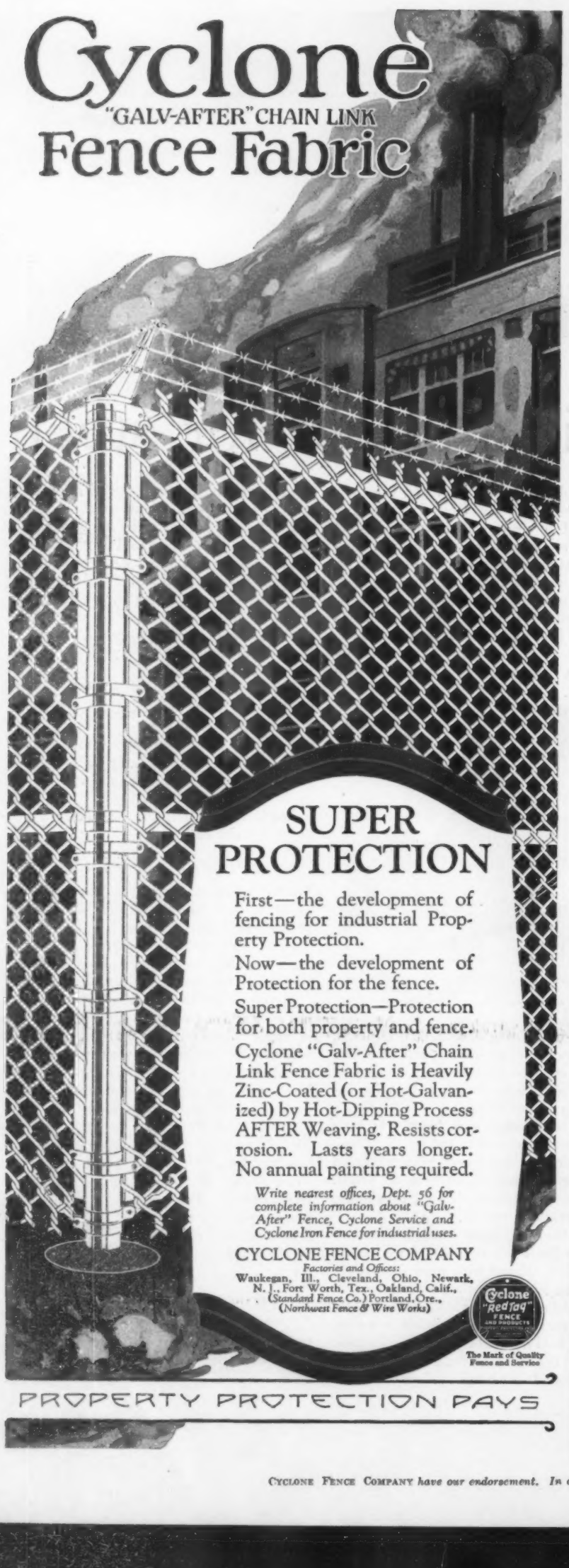
We have a special booklet, "Protection of Structural Metal," which we shall gladly send to anyone who is interested. This booklet contains information telling when and how to give red-lead paint protection to structural iron and steel.

If you desire to read more about the use of lead, not only in paint but also in many forms and for many purposes which will surprise you, we can recommend a number of interesting books. The latest and probably the most complete story of lead and its many uses is "Lead, the Precious Metal," published by the Century Co., New York. Price $3.00. If you are unable to get it at your bookstore, write the publishers direct, or we shall be glad to place the order for you.



NATIONAL LEAD COMPANY

New York, 111 Broadway; Boston, 131 State Street; Buffalo, 116 Oak Street; Chicago, 900 West 18th Street; Cincinnati, 659 Freeman Avenue; Cleveland, 820 West Superior Avenue; St. Louis, 722 Chestnut Street; San Francisco, 485 California Street; Pittsburgh, National Lead & Oil Co. of Pa., 316 Fourth Avenue; Philadelphia, John T. Lewis & Bros. Co., 437 Chestnut Street.



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New Methods of identifying pictures have been perfected by French chemists, according to the American Chemical Society. They use groups of red, blue, green, or white light to light the picture, and they examine the suspected canvass with the spectrometer. Employment of these various colors puts in relief the retouchings, scrapings and changed signatures which constitute a false picture. By employing the ultra-violet ray they make the zinc white and certain varnishes stand out by fluorescence. Finally, by scraping off very small amounts of paint, they have made spectrographic analyses of them, and have been able thus to determine for example, in a false Renoir, the presence of a cadmium yellow, when Renoir only used chrome yellow.—*Seience.*

France Controls Alsace Potash.—Complete proprietorship of the Alsace potash mines has been gained by France, according to an announcement from Mulhouse late in May. Complete control was acquired by assuming the payment of 200,000,000 francs in 20 years. The situation is favorably regarded in France, as the mines are expected to return a profit of 100,000,000 francs this year. The principal features of the proposed operations comprise working the mines for a period of 75 years by a French stock company, with provision for the workmen sharing the profits. The capital of this new organization will be divided, 50 per cent to be provided by agricultural syndicates that may choose to interest themselves therein, 10 per cent to French industries using potash salts in one or another of their forms, 5 per cent to those of the Haut-Rhin and the Bas-Rhin and Moselle departments that may have suffered war damages, 15 per cent to various departments and communes of Alsace and Lorraine, 15 per cent to former shareholders of Lorraine and French citizens who may have held stock in the former companies operating these deposits and 5 per cent to the personnel of all grades employed in the mines.—*Chem. and Met. Eng.*

Photographs Through a Compound Eye.—It is a common experience, says *British Mechanics*, to find in many nature books illustrations of photographs taken through the compound eyes of various insects, showing the photograph of a person in each facet, and it is often stated that in consequence of this series of the same image that insects have the power of seeing a person or some object in each of the facets when it is alive. This statement, according to the latest investigation, is entirely wrong, and what is really shown in such illustrations is not a compound eye at all, but simply the flattened out *cornea* of the eye. Photographs taken through a compound eye, an extremely difficult operation, show quite another feature to that generally assumed and the images are composed of similar images partly superposed and pieced together to form a blurred reconstruction of the original. In rapid flight an insect can see clearly the objects it passes, whereas with a small angle instead of a wide angle, insects would be constantly running into one another. To easily understand this, one has only to travel at a rapid rate and notice how objects on the roadside appear to run into one another, or as when traveling in a train, the telegraph poles rushing past the window shows this effect very clearly.

Belgium Comes Back.—The revival of the steel industry in Belgium has been continued with much courage and patience, as the difficulties faced, especially financial were enormous. Through the initiative of the Belgian manufacturers and the ability of their workmen, Belgium has obtained very appreciable results, and the country now stands side by side with the largest steel producing countries, such as the United States, England, France, Germany. It competes with them on an equal footing in the markets of the world.—*Iron Trade Rev.*

Motor Liners for the English-Australian Mail Service is the proposal now being mooted in British shipping circles. This service has for its ultimate object the cutting down of the time taken for mails to reach Australia from England to nineteen days, and for this purpose a twenty-knot ship would be required. With a ship of 700-foot length and load draft of twenty feet, 27,000 H.P. would be required. These ships would have to be subsidized at the rate of 75,000 pounds per annum. Cabin and steerage passengers, only, would be carried. The interesting part of the plan is the use of some type of internal combustion engine. The ease with which Diesel oil can be obtained in the Far East, combined with its cheapness there, and the fact that it is not necessary to bunker at the home end of the voyage are other points in favor of the proposal.—*Marine Eng. and Naval Arch.*, 46:554, p. 390.

The Possibility of Overcoming the Moth Plague entirely within a few years is the conviction of those chemists who have been experimenting with what is known as the Eulan process, as developed by the Bayer chemists of Germany, after six and one-half years of experimentation. The experiments were both of a chemical and zoological nature, and tests carried out by an American chemical company have proved the process to render wool and all materials consisting of animal fibers wholly immune from the attacks of moths. The most interesting tests made were those in which two pieces of the same material, the one treated by the Eulan process, and the other not treated, were placed in the same receptacle stocked with numerous moth worms. Upon inspection several months later the treated specimens proved to be wholly unaffected by the test, while the untreated specimens were reduced to a fragmentary condition. The new treatment has no effect on the colors of dyed wool, nor on the appearance of the material, and has the advantage of being entirely odorless. None of the valuable properties of the wool are affected by the treatment, and it may be used for furs, carpets, tapestries, and all materials consisting of the keratin common to animal fibers. The treatment is remarkably cheap, adding less than three cents per yard to the cost of the material.—*Tech. Eng. News*, 4:5, p. 172.

Typhoid Carriers of record within the State of New York increased from 86 to 108 during the year 1923, according to *Health News*, the weekly bulletin of the New York State Department of Health. The figures include 15 carriers in state hospitals at the beginning and 18 at the close of the year; and in addition, 4 died, 1 moved out of the state, 3 were returned to the list, and 21 new carriers were located. Of the 21 new carriers, 4 were working on dairy farms when located and 1 of these is held responsible for 25 cases of typhoid fever, and the remaining 20 for 44 cases.

Wealth of the World.—The aggregate pre-war wealth of the twenty-odd nations actively engaged in the great war, according to an estimate just completed by the research department of the Bankers' Trust Company of New York, amounted to $630,000,000,000. The wealth of these same nations today is estimated to be about $619,000,000,000. The pre-war wealth of the British Empire—that is, of Great Britain, the Dominions, India and the Crown Colonies—was approximately $140,000,000,000, while today the wealth of this same group of nations is estimated by the Bankers' Trust Company to be around $149,000,000,000. The wealth of France before the war is placed at just under $60,000,000,000, and is estimated to be approximately the same today. The pre-war wealth of the United States is placed at $200,000,000,000 and the wealth today at $230,000,000,000, while the pre-war wealth of Germany is estimated to have been upward of $80,000,000,000 and today to be about $55,000,000,000. These figures are all on the gold pre-war basis of values, having been adjusted for inflation. The per capita wealth of Great Britain today is placed at $1489 and of the different nations composing the British Empire at $418, including the wealth and population of India. The wealth of France is estimated in 1913 to be $1484 per capita and of the United States $2090 per capita. The wealth of Germany is placed at $901 per capita. The Bankers' Trust Company points out that the total wealth of the former belligerents has not materially changed as a result of the war, but that there has been a marked redistribution of such wealth, this redistribution having taken place not only as between nations but also as between the peoples within the boundaries of each nation. —*Mfrs. Rec.*

The Manner in Which Sheffield Plate Was Discovered was one of those strange accidents by which art and commerce are occasionally enriched. This is the story of it, which Mr. Little wrote for *Jewelers' Circular*, and which is reprinted by permission in *Brass World* (20:4, 3pp., ill.). It was discovered by accident by Thomas Boulsover, who was an ingenious mechanic in Sheffield, England. It is said that he was repairing the handle of a pocket knife composed partly of silver and partly of copper, and in making his repairs he accident-

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ally fused the two metals. He at once conceived the idea of uniting these two metals and using this as a substitute for making articles which had hitherto been made of sterling silver only. He seems to have specialized in making small articles such as buckles, buttons, snuffboxes and patchboxes, some of which were only half an inch in diameter, and did not attempt to make larger articles. He did not appreciate how important his discovery was, nor did he have the vision or imagination; so, like many inventors, he did not reap the full results from his remarkable discovery.

Industrial Progress

Rolls for Nearly all the Cold-Rolling of Strip and Sheet Metal were formerly made of chilled iron. Recently, however, this material has been replaced by hardened, ground, and polished rolls of alloy steel, containing chromium, chromium and vanadium, chromium and molybdenum, or all three metals, as well as chromium, tungsten, and vanadium. It is stated that rolls made from these materials can be made much harder than chilled iron rolls. They also take a higher finish, producing a corresponding better surface on the product. Molybdenum steel is also employed for rolls in blooming mills and roughing mills.—*Machinery.*

A New Use for Beryl.—Beryl is commonly one of the accessory minerals in pegmatites, where it occurs in well developed crystals. These crystals are occasionally very large, instances being known where single crystals weighed as much as 3000 pounds. Transparent beryl suitable for gems is, however, very rare; practically all the beryl found is translucent or opaque, and worthless for this purpose. In feldspar and mica mines it has been the practice of workmen to break up any beryl crystals which they encountered in search of transparent fragments which might have gem value, discarding the rest of the material as worthless. Until recently this opaque beryl was considered to possess practically no commercial possibilities, although small amounts have been occasionally shipped to Germany for the manufacture of beryllium salts and metallic beryllium which is said to alloy with iron, forming beryllium steel possessing very desirable properties. Investigations by the Bureau of Standards have shown that when beryl is substituted for feldspar in the manufacture of porcelain in amounts varying from 25 to 45 per cent of the total mixtures, the other components being silica and clays, a product is obtained which displays a very high electrical resistance and low thermal expansion. This porcelain is therefore considered a very promising material for electrical uses. At present, beryl is quoted at 4½ cents a pound.

The Making of Synthetic Cast Iron in a commercial electric furnace is the subject of tests which have been completed by Department of the Interior Engineers at the Seattle, Wash., experiment station of the Bureau of Mines. Both synthetic gray iron and mild steel were produced in alternating runs without trouble. Miscellaneous steel scrap of all kinds was charged into the furnace to produce various grades of iron. The results show that, under the conditions in this foundry, the synthetic product can compete with cupola iron, and is superior in quality and strength. These results will be applied in the melting of sponge iron, and in the melting of scrap at foundries.

Fixed Nitrogen.—Recent visitors at the Fixed Nitrogen Research Laboratory, Washington, have been much impressed by the new developments of that laboratory typified in the small direct synthetic ammonia plant now being operated with a capacity of about one-quarter ton per 24-hour day. This plant, which has attracted much attention, is based upon the results of five years research of the Government specialists. It has already demonstrated that certain of the new principles which they propose can be operated successfully, at least upon a semi-commercial scale. —*Chem. and Met. Eng.*

Silica Gel.—During the World War charcoal, so far the chief adsorbent of the chemist for gases and certain impurities, found a rival in silica gel, and it was observed that this mineral colloid would also extract petroleum hydrocarbons, suitable for use as a motor fuel, from coal gas and coke-oven gas. Industrially the problem has chiefly been taken up in the United States. When silicates are decomposed by acids, the silicic acid remains for a few minutes in the state of a true solution and diffuses through a membrane, but it soon assumes a colloidal gelatinous character. In that jelly each

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—in power plants and pulverized fuel plants by protecting crushing equipment
—in quarries by protecting crushing equipment from breakage
—in cotton seed mills by protecting linters and hullers
—in garbage reclaiming by removing cans
—in the manufacture of drugs, chemicals, sugar, salt, food products, cattle and poultry foods, batteries, carbon, ammunition, chicory, crucible clay, gas mantles, copra, vegetable oil, chocolate and cocoa, paper, pulp, ink, abrasives, glue, brewery products, talc, celluloid, starch, asbestos.

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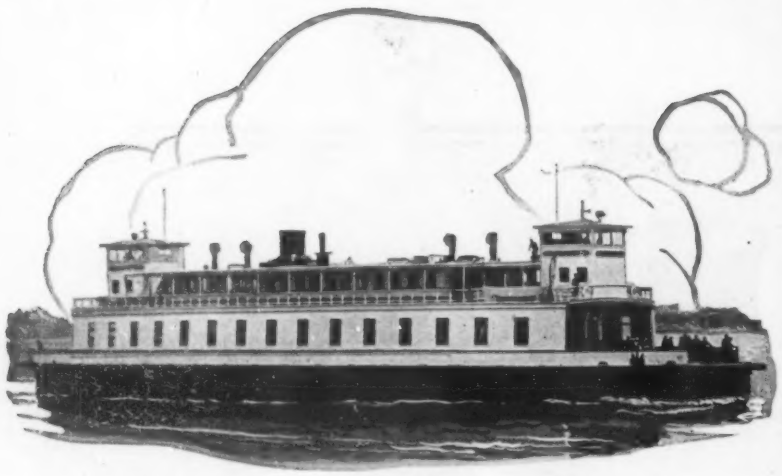

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On such a beautiful sheet of water as San Francisco Bay a smart and shipshape ferry is particularly welcome.

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This monogram is on the motors which drive electric ferryboats, fireboats, cargo boats, and great U. S. battleships. It is the emblem of the General Electric Company, an organization which produces machinery by which electricity does more and better work.

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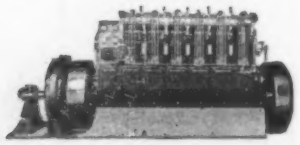

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molecule of silica may confine a hundred molecules of water, yet it forms a stiff elastic structure probably differing from those of other gelatinous hydroxides, such as iron and aluminum. As the silica gel dries it first contracts and forms a glassy, very highly porous mass, apparently full of capillaries which in adsorbing vapors become filled with the condensed liquid. Silica gel may be heated to 600 degrees Centigrade, without decrease in its efficiency. The heating is really indispensable because the adsorbed vapor is liberated again by these means. Over the ranges of commercial processes benzene, it was ascertained, can be adsorbed from coal gas, even when saturated with water vapor, though the gel would only take up 10 per cent of its weight of benzene. Since wash oils only take up about 4 per cent of benzene and the benzene from the gel is free from pre-benzole and naphthalene without chemical refining, the gel adsorption is certainly promising. In spite of difficulties the results obtained are considered sufficiently encouraging for planning a full-scale adsorption and refining plant in England, and the new process will doubtless spread throughout the world.—*Cement, Mill and Quarry*, 24:11, 1 p.

Rubber Latex Developments.—A continental technologist, Dr. Rudolph Dittmar, of Gratz, has specially interested himself in the direct utilization of rubber latex. One feature of his work which appears to be novel in character is the conversion of the usual compounding ingredients, such as resin, zinc oxide, sulfur, etc., into the colloidal condition in a Plauson colloid mill, and then mixing them in water suspension with rubber latex. Such compound latices he claims to be of special use as proofing materials, and suggests the use of it as a preservative for any masonry which is porous in texture, such as sandstones, plasters and concretes. An extension of this idea to the impregnation of wood with compound latex in order to make it water- and weather-proof appears to offer points of novelty—the wood being first dried at 100 degrees-103 degrees Centigrade, and while still warm soaked in latex for 20 minutes and then dried. He suggests that possibly some of the old Italian violin makers may have prepared the best of their wood by impregnating it with the latex of *Ficus*, and the microscopic detection of an elastic filling substance beneath the varnish of some old violins points to this hypothesis not being so far fetched as would at first sight appear. It will be passing strange if the subtle tones of a Stradivarius or Amato masterpiece are eventually traced to and laid to the credit of this wonderful colloid rubber.—*Jour. Roy. Soc. Arts*, No. 3721.

A New Form of Rubber termed Onazote consists of rubber expanded into a spongy condition by gas under pressure, but differing from ordinary rubber sponge in that the cavities are unbroken, and remain filled with gas under pressure. The rubber itself is vulcanized and according to the degree of vulcanization, the resultant product is either a soft resilient substance or a hard expanded vulcanite. Owing to the extreme expansion which the material undergoes in the special process of manufacture, a product of extraordinary low specific gravity can be obtained, and furthermore the gas cavities being unbroken and discontinuous, the material acts as a highly efficient non-conductor of heat.—*Jour. Roy. Soc. Arts.*

Casting in Permanent Molds makes possible the quantity production of intricate iron castings by unskilled labor, using metal molds. Previous to the last decade, the use of metal molds was largely confined to the non-ferrous field. The new development is the result of studying the production of intricate castings in large quantities, having a uniform homogeneous structure. The regulation of the cooling rate, which was obtained by the following steps, was found to be the important factor: Controlling thickness of walls in the hollow metal mold, which are approximately one-half inch thick. The molds are of ordinary gray iron, cast to shape in a metal mold. Providing a heat barrier between the molten iron and the metal mold, consisting of ordinary fire-clay with a heat-resisting binder. This barrier is called a "stone facing" and is from 0.01 to 0.015625 inch thick. Protecting of this stone facing after each casting by a coating of lampblack, applied by means of a smoky flame. Preventing the expansion of the iron when freezing, by holding the parts of the mold together by powerful springs. Controlling the temperature of the molds, a slight artificial cooling by a blower or a fan giving increased production. Cleaning the molds after each casting. This is done by air blast, not only to blow out the sand and dirt, but to insure a fresh coating of lampblack. All ranges of mixture of iron from ordinary malleable to ordinary cast iron have been successfully used. The shrinkage of the iron casting is about one-half that which would be expected when using a sand mold, probably because the iron takes the shape of the mold during the expansion stage rather than during the contracting stage.—*Machinery.*

A New Process of Centrifugally Casting Iron Pipe is announced in *Iron Age* (113:23, 1 p., ill.). The new sand-spun process just introduced employs the sand mold in a new way. In carrying out this new method the metal, at predetermined temperatures, is poured into a rapidly revolving sand-lined flask, against which the metal is cast without any chilling action. In addition to this, the centrifugal action of the mold, together with further manipulations thereof, serve to distribute the molten metal evenly throughout the length of the mold, thus securing a pipe a uniform thickness from end to end. The speed or revolution of the mold is such as to cause the metal to be exceedingly dense and solid, thus increasing its tensile strength by more than 50 per cent and making it tough and hard to fracture, yet without interfering in the least with drilling or tapping for service pipe or turning down or threading the exterior or interior for any desired purpose, because all chilling is avoided. An important feature of this new process, employing the sand-lined flask, is that pipe may be cast of any thickness, heavy or light. Another very important feature is that not only the bell, but the spigot or bead end can be formed by this new method just as easily as it has always been formed by the old sand cast method. A refractory lining which is applied to the sand mold before casting prevents the burning of the sand to the iron and avoids all scabbing. The sand in the flask is held in place by the centrifugal action. The refractory material which has been applied to the sand mold is of such a character that during the casting operation it becomes incorporated by a fusing action with the outer shell of the casting, thus forming a very desirable and attractive coating which prevents the formation of rust or corrosion and acts as a protection to the pipe. This new sand-spun pipe is now being regularly made and marketed. Enlarged and up-to-date foundries are being built and old plants are being reconstructed for the installation of the new method, all of which will supersede the methods now employed.

Seek New Uses for Slag.—Betterment of present methods of utilizing the slag produced as a waste product of blast furnaces, and research looking toward the development of new methods of using it were discussed at a conference of the National Slag Association held at the Bureau of Standards, Department of Commerce, recently. In addressing the conference Mr. P. H. Bates of the Bureau of Standards called attention to the fact that slag is now used in Europe for making "Eisen Portland cement," which consists of about 35 per cent of ground slag and 65 per cent of Portland cement. He expressed the opinion that such use would ultimately develop in this country. Eisen cement is nearly as strong as Portland cement, he stated, and is also thought to be more resistant to attack by sea water and by alkali.—*Forging—Stamping—Heat-Treating.*

A New Method of Lining Boiler Furnaces.—The modern method of operating boilers at 200 to 300 per cent rating has permitted a decrease in boiler-room investment. Unfortunately, the high furnace temperatures accompanying such ratio of heat transfer rapidly destroy ordinary furnace linings to such an extent that boiler ratings are dependent upon the character of the refractories used in the furnace. While there are more grades of brick than good, bad and indifferent, even the best quality will spawl after more or less service, and the cost of renewing portions of, or all, the lining runs from 10 cents to 30 cents per square foot of boiler-heating surface per year. This, even in a plant of 50,000 square feet of boiler surface, is a serious item. While various kinds of cements and plastic materials have been used as a patching material with more or less success, strangely a most successful and economical lining material has been found to be a combination of crushed used firebrick, fireclay and sodium silicate (water

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glass) applied by means of an air gun in the form of a spray. By this method a dry mixture of the refractories to be used is placed in a closed receptacle and by air pressure is forced out through a hose and nozzle. Water mixed with water glass is added to the dry mixture at the nozzle, but only to an extent to give hydration; that is, just enough to make the mixture a plastic mass, but not enough to permit water to be squeezed out upon being pressed. This plastic mass leaves the nozzle with considerable velocity and on striking the furnace walls not only forms a covering, but apparently penetrates the fused surface sufficiently to form a bond with the old material.—*Power*, 59:26, 3 pp., ill.

Manufacturers of Hack-Saw Blades, representing about 60 per cent of the output of the United States, took initial steps recently at a meeting in the Division of Simplified Practice, Department of Commerce, to reduce the variety of sizes of that commodity. It was shown 460 sets of specifications as to sizes are offered by 15 manufacturers, and a preliminary study indicated that probably 95 per cent of demand came from 47 of these sizes.—*Iron Trade Rev.*

Sheet Bars Cast Centrifugally.—The idea of making sheet and plate bars without ingot casting, or soaking and blooming, but instead to cast directly long slender bars and submit them to the simplest and cheapest kind of rolling, is sufficiently revolutionary to justify a reasonable amount of caution on the part of steel men—at least until it has been shown by facts that it can be actually done. It also involves too many disturbing economic possibilities to be neglected by steel men—if they are wise. The basic idea of the new process is that, by the use of the so-called bottle-neck mold, bars or ingots may be cast centrifugally without the formation of cold shots which usually accompanies all attempts to cast centrifugally in divided molds. In the bottle-neck mold, the metal is fed against the smooth part of the mold. It is then propelled by centrifugal force, or rather by the pressure produced by it, along the axis of the mold so that by the time it reaches the partitions, the metal is already whirling at the same speed as the mold. There is, therefore, no blow, and the metal flows gently past the partitions, filling the intervening spaces. Thus far, two machines, both operating successfully, have been constructed. One, making four bars, 4 inches by 4 inches by 8 feet 9 inches, is in a plant as to which, for legal reasons, no information can be published at this time. The other machine, making small bars ¾ inch by ¾ inch by 12 inches, is at present at a plant in Niagara Falls, N. Y., making a series of experimental runs on various alloys.—*Iron Age*, 113:26, 2 pp., ill.

The Unusual Feature about a new California cement manufacturing project is that all the required raw material, containing no elements other than lime and clay, except the necessary small proportion of gypsum, will be recovered from the bottom of San Francisco Bay by a suction dredge. The material consists of a vast bed of oyster shells, and possibly shells of other kinds, the interstices between shell units being filled with a silt-like clay originally deposited there by water. The deposit of this material is of considerable depth and of an area covering the southern arm of the bay. The one suction dredge required for the first unit of the plant will be equipped with a 16-inch centrifugal pump, driven by a six-cylinder semi-Diesel engine, giving the pump a capacity to take up material at the rate of 200 cubic yards per hour, discharging it onto a 600-ton barge. A second Diesel engine is being installed on the dredge boat for operating the hoist and cutter.—*Cement, Mill and Q'y.*

New Uses for Rubber.—The rubber situation has been somewhat akin to that of copper: nothing has been wrong with consumption, but production has more than kept up with it, so that prices are now about 20 cents per pound, whereas before the World War they were around 50 cents, possibly much too high. Of particular interest is the use of rubber as a lining for ball mills, a development of great promise, though such linings have so far had such limited use that it is too early to say that they are better than steel. Rubber linings and impellers for centrifugal pumps have proved their advantages over metal where erosive pulps must be handled. Rubber impellers in flotation machines have far outworn those of wood or metal at several mills. Rubber riffles for concentration tables have been found better than wood at some of the big Missouri lead concentrators, and rubber launder linings are used in the Far East. Rubber paving for streets is being tried in Boston, a mixture of two-thirds old automobile tires and one-third new rubber being used, at a cost of about $15 a square yard. In London, rubber tennis courts are being tested.—*Eng. and Min. Jour.-Press.*

An Advance in Forging Industry.—Until recently the only way to examine the structure of the bore of a forging was to use a fixed external telescope something like an engineer's transit in connection with a 45-degree mirror. In England, an instrument has been developed which is in reality a periscope provided with a lens close to the point of examination. The instrument is 1½ inches in diameter by 13½ feet long. It is provided with six lamps on the end which illuminate the whole periphery of the bore. This instrument permits the whole circumference of the bore to be examined at once, much as if one were looking down a tube with one eye, except that the structure is shown considerably magnified. By means of these instruments every mark, scratch, discoloration, or stain can be seen. The result is the same as if the forging were split from end to end into two halves and examined through a reading glass. In other words, the instrument is intended to give the examiner the sense of having inspected the whole surface of the bore while illuminated, by a powerful magnifying glass.—*Iron Trade Rev.*

The Shorter Day in Industry is largely made possible through the work of the inventor, says J. H. Barnes, president of the Chamber of Commerce of the United States. Few bother to think about the effects of the brain of the inventor, but a summary makes a concrete picture of the importance of its workings. Here it is: In the steel industry, one or two men now with unloaders, replace 12 to 20 men unloading by hand. In furnace charging, by use of skip hoist, larry car and automatic weigher, two men replace 14. In pig casting, seven men with casting machine replace 60. In open hearth operation, one operator with charging machine replaces 40 hand charges. With traveling cranes, 12 men pouring, replace 37. Two men unloading pig iron with electric magnet and crane replace 128. In the clothing industry, six men operating two boarding machines replace 20. One girl operating rib-cutting machine produces 25 times more than by hand. In men's clothing, in various processes, machines with a single operator replace six and eight workers. In the shoe industry one lasting machine produces the equivalent of six to ten hand workers. In the glass industry, one type bottle making machine replaces 54 workers. In window glass, production with a machine blower increases 30 to 50 times. In coal mines an automatic conveyor for pier unloading with 12 men replaces 150 men.—*Brass World.*

Dispersed rubber, a new development, now occupies the interest of rubber manufacturers. One invention for use in connection with this discovery is outlined in *Chem. and Metall. Eng.*, (30:10, 3 pp.) The object of this invention is stated to be to disperse crude or coagulated rubber in water so as to produce a mass of such consistency as may be desired, in which the rubber is in the form of globules of substantially the same size and form in which they occurred in the original latex from which the crude rubber was coagulated. The rubber compound can be spread upon fabrics and after the removal of the water, the cloth may be used in the manufacture of tires, hose, rain coats, vehicle tops, etc. The dispersed compounds may be used as cements, in the rubber factories, or in any other place where the ordinary solvent cements are used. Spreading is, of course, one of the examples of the use of cements. One of the most interesting developments is in connection with the use of dispersed rubber in the making of paper, for not only is it possible to add crude rubber alone, as is done in the case of latex, but other substances, such as oils, waxes, etc., can be dispersed along with the rubber in one operation, and the entire mass incorporated with paper pulp. Or this dispersed rubber may be spread on the surface of prepared paper or cardboard as a surface coating. Moreover, experience has shown that by employing the proper lubricant a better adhesion can be obtained be-

(Continued on page 206)

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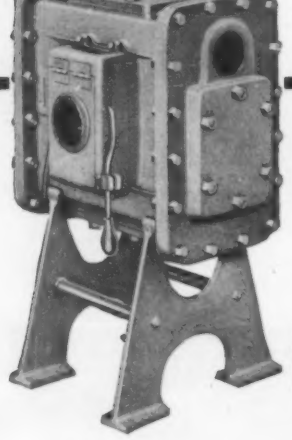

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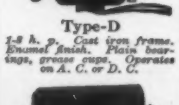

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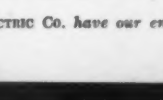

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tween paper and dispersed rubber than between paper and latex. By the introduction into the compound of the necessary vulcanizing substances, paper prepared with dispersed rubber can be vulcanized. Dispersed rubber has been used to supply the binder used in making rubber tile, for covering floors and walls. The fillers, which may be ground leather, asbestos, cork, cotton or inorganic pigments, are simply mixed with dispersed rubber and applied with a trowel, and then allowed to dry.

An American Alumina Cement.—After some nine months of experimentation, which involved a thorough study of manufacturing processes as well as such physical tests as were possible in that period, an American cement manufacturer has put on the market an American alumina cement. Ever since the war there has been growing interest in this quick-setting high-strength hydraulic cement, which proved so effective in the emergency work at the battle front, and which the French seem to be demanding faster than the manufacturers can supply. Up to now, however, American engineers could learn about it only through reports of tests on the French product—which was hardly obtainable in this country—and through some limited tests on some similar cements manufactured in test quantities only by the Bureau of Standards here. These reports show the material to have remarkable possibilities for some special types of work. Concrete made from it, for instance, in the ordinary proportions gives test strengths in twenty-four hours equal to or greater than that of portland cement concrete in twenty-eight days. It is not a flash cement; for the first few hours its process of setting is quite comparable to portland, but sometime between four and twelve hours its strength shoots straight up. For emergency work, such as street repairs, rail crossovers, oil well linings, concrete floor finish, grouting, etc., this is a tremendous advantage, and the possibilities of use in concrete piles, or even in bridges and buildings where form reuse is important, are obvious.—*Eng. News-Record.*

Jamshedpur, in India, may some day be another Pittsburgh. Extremely few spots in the world, unless it be Birmingham, Alabama, are provided with contiguous supplies of iron ore with the fuel and flux for smelting it. Shortly before the European war, says *Mfrs. Record* (85:21, 1 p.), an American engineer, who is the manager of a big iron plant in India, in an address before the American Iron and Steel Institute warned his hearers of the certainty of severe competition which the iron and steel men of this country would face whenever India produced more than enough to supply its local demand. He said that the plant of which he was manager employed about 8000 hands, and the rate of wages, including all skilled labor, amounted to between seven cents and eight cents a day. Possibly as a result of the war conditions the wages have been advanced a little beyond that figure, but we doubt if very much change has been made, for a few days ago a large American company announced that it would build plants in India and ship its products to this country, and gave as a reason that it could secure labor at about fifteen cents to sixteen cents a day; but added that this was much above the normal rate and due to war conditions, and that lower wages would probably prevail later on. These facts are worth considering in the light of a purchase recently made by a Lynchburg foundry company of 2000 tons of India-made iron. The president advises that his company has purchased 2000 tons of India-made iron for shipment through Norfolk to Lynchburg at approximately $2 lower than the rate at which they could buy domestic iron.

Several Unusual Features in the operation of a crude oil refining plant, believed to represent increased efficiency and economic saving, are embodied in a portable refinery recently put in operation at Luling, Caldwell County, Texas. All equipment is carried on specially built steel railroad cars, being permanently attached to these cars and operated from them. The plant may be moved from one oil field to another with virtually no loss in salvage. When a new oil field is discovered it can be rushed across the country to that field by rail, intact. The process of moving consists simply of dismantling the detachable equipment, such as pipe connections, smoke stack and rectifying tower, coupling up the two steel cars carrying the permanently attached equipment to a freight train and consigning the plant to its new destination. The refinery can be placed in operation within 8 or 10 days after the cars on which it is built are spotted. Four or five days are required to dismantle connections and place it en route again, when it is desired to move.—*Iron Age*, 113:20.

Recent Advances.—Oxygen in gas-making and for metallurgical work is one of the striking recommendations of recent months. The only commercial attempt in this field is about to begin at Worcester, Mass. The use of the back-run water-gas process is a striking chemical engineering achievement of the past year or more. The use of bituminous coal in water-gas generators and the application of accumulators in water-gas plants have both been conspicuous advances of recent months. The accumulator so applied is a large tank of hot water intended to take up excess exhaust steam by condensation and subsequently to give it up by boiling when the deficiency of steam causes a small drop in pressure. This accumulator acts as a balance wheel on the steam line to the water-gas machine and stabilizes steam generation, with consequent economy. Most important results in blue water-gas plants have come from English reports by the Fuel Research Board and the Institution of Gas Engineers. The slagging type gas producer has also received attention in Europe, particularly in Germany and in France, where the advantages claimed for it are high capacity, use of high ash coal and low labor cost. Its adaptability to the steel industry is suggested. Liquid purification by the Seaboard process is mentioned as the most conspicuous advance recently in this phase of gas production. The sale of gas on the therm basis in England also suggests similar possibilities in America. The closest analogy yet adopted in this country is in Colorado, where gas companies choose their own gas standard. House heating by gas is an important prospective use.—*Chem. and Met. Eng.*

Present-day Practice is tending decidedly towards the use of high steam pressure and temperatures. For several years, plants in this country have been operating a 350-pound boiler pressure with temperatures up to 650 degrees Fahrenheit. In Europe, considerable experience has been had particularly with high superheats. At the present time, plants are under construction in this country which will operate at from 550 to 650-pound pressure and with steam temperatures approximating 750 degrees Fahrenheit. Boilers are also being built which will operate at 1200-pound pressure. The design problem presented by the use of high pressures is not considered difficult, in fact it is no more difficult to design a valve for 600-pound pressure than it would be to design it for a pressure of 200 pounds. The problem becomes complex when high temperatures are considered. To build a valve to withstand a high pressure means merely the addition of properly distributed metal but, when the temperature is increased from 450 to about 800 degrees Fahrenheit, certain physical characteristics of the metal have changed. Its strength has been reduced and certain metals which could be used for high pressure and low superheat cannot be used for high pressures and high superheats.—*Power Plant Eng.*

Efficient Use of a By-Product.—A Pittsburgh plate glass manufacturer will begin operations in June in a new cement plant, which is rapidly being completed at its quarry site at Fultonham, O. No doubt many will ask the question: Why is a plate glass manufacturer taking up the manufacture of portland cement? The answer is: To use up a by-product or waste material from its present large crushing plant. In 1920 this company built and put into operation a 3000-ton crushing plant at Fultonham, to supply limestone to the chemical plant at Barberton, O., where all the soda ash is manufactured, which the company uses in the manufacture of glass. The chemical plant uses about 60 per cent of the output of the quarry which takes all the limestone from 4 to 8 inches in size, leaving all the stone under four inches to be recrushed and sold for concrete and highway work. In the crushing of this stone there is produced from 500 to 600 tons of fine stone running from dust up to three-quarters inch. This includes the fines and dirty stone which is screened out of the first crushing and in the secondary crushers which crush the four-inch stone down. This 500 to 600 tons of fines and dirty stone is waste material and was hauled out and dumped over the spoil bank along with the quarry stripping. So

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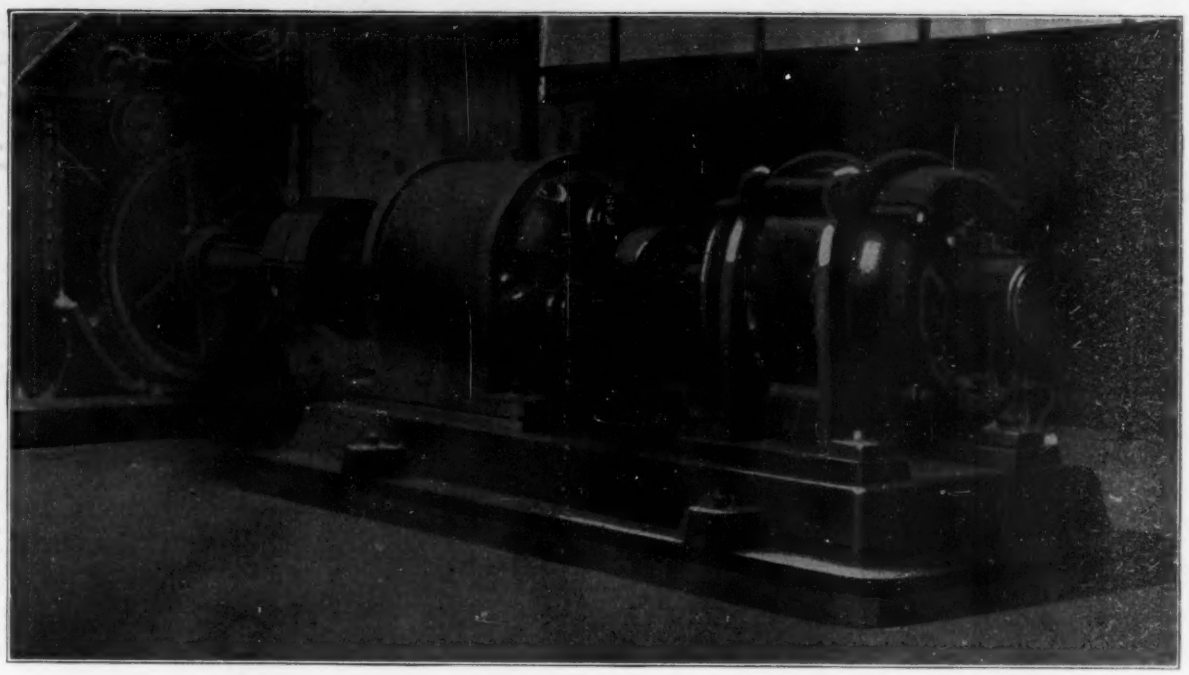
the question arose to find some use for these screenings. It was found upon investigation that there was a deposit of shale 40 feet thick underlying about 40 acres of the company's property, and that the hills nearby had a deposit of shale 100 feet high, all of which is of the proper analysis for the manufacture of portland cement. After these investigations were completed, the company decided that to save this waste of fine stone it would be a paying proposition to build a 2500-barrel cement plant and utilize all the screenings and dirty stone left in the manufacture of soda ash.—*Cement, Mill and Quarry*, 24:9, 4 pp., ill.

The Rapid Progress Made by the South in recent years, and the extent of its wealth today is visualized when it is realized that the value of all property in the South increased from $17,919,200,000 in 1900 to $71,358,707,000 in 1922. In other words the wealth of the South today is nearly four times what it was in 1900, and is about $1,000,000,000 more than the value of the country's wealth outside of the South in 1900, and $28,000,000,000 more than the wealth of the entire United States in 1880. Upon examination of the percentage figures compiled for individual Southern States it is found that North Carolina heads the list with an increase of 175.7 per cent in wealth since 1912, followed by Florida with an increase of 162.9 per cent, and Tennessee with 129.2 per cent.—*Mfrs. Record*, 85:17, 2 pp.

Casting Irregular Objects Centrifugally was the problem successfully attacked by two workers who describe their results in *The Foundry* (52:9, 3 pp., ill.). After a careful search of the literature and the patents, it was found that little information was available covering centrifugal castings more complex than simple hollow, open end cylinders. The problem faced was difficult. The principle used in casting a pipe could not be applied directly because in this case only two motions are necessary, namely the rotation of the mold about a single axis. When it becomes necessary to cast a solid object, the problem becomes much more complex and many difficulties present themselves. Our experiments were confined entirely to the nonferrous field. It is well to note that we chose for our objects to cast, such complex shapes as would present as many difficulties as possible so that results would apply to any object. Elephants, dogs, cows, horses, deer, bears, etc., present not only problems that are met with in casting pipe, where the body of the animal corresponds to the pipe, but these objects present such difficulties as casting long slender legs and peculiar curves that make it difficult to determine the axes of rotation. These objects also required complex rotation to give completely closed, hollow castings. To point out the value of a hollow closed casting, many objects cast are of such a size that the weight is undesirable where great strength is not essential. Since by this method it is possible to make a serviceable casting of one-fifth the weight of a solid casting, the desired lightness is attained, to say nothing of the fact that one pound of the metal will make five times the amount of the finished product. Here is a great commercial point. Since the metal is cast centrifugally the grain structure is fine, the tensile strength is increased and the resulting casting a great deal stronger than it would be, if it were possible to make it in sand. Further the permanent or long life mold used results in additional economies. One mold will make many thousands of castings in a short time and the accuracy of the castings thus is assured. The working conditions also are improved as the dirt and dust of a normal foundry are absent.

Oil Shale.—An immense amount of research work has been directed toward ways and means of distilling shale for the recovery of the shale oil. There is no gainsaying that there are possibilities in several of the processes developed in the laboratories, but a drawback to the commercial success of shale-oil distillation lies in the fact that the oil recovered must be sold in competition with petroleum oils, such as gasoline and kerosene. The cost of distilling petroleum is much less than that for shale oil, and as long as the supply of petroleum is equal to consumption there is little hope for the shale-oil industry. There is, however, no reason why the immense deposits of shale should be totally undeveloped. It happens that shale is fairly well distributed throughout the world. Whenever coal is scarce or expensive and a shale bed is available, the shale can be burned in the boiler furnaces with entire success. In Esthonia, a part of



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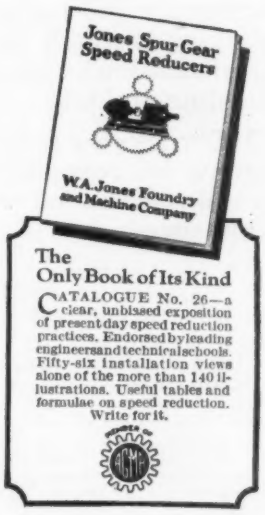

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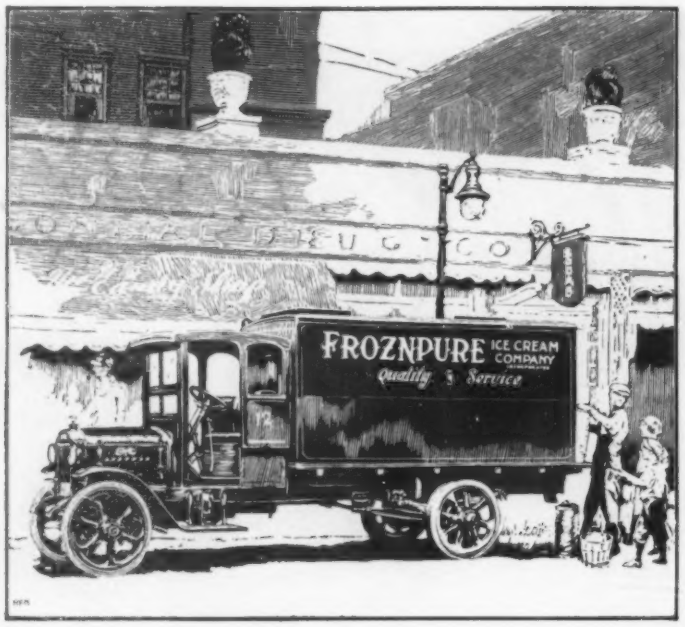

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old Russia, shale has been used for a number of years under boilers and in house furnaces. The railways made use of thousands of tons, a special furnace with revolving grates being used. Cement mills of that country grind the shale and blow it into the cinder mill. The shale residue, after the oil content is consumed, drops into the clinker and becomes a part of the cement composition.—*Power.*

For America to Produce Her Own Rubber, as is again being energetically advocated in some quarters, involves not so much a question of location and climate, as many seem to think, as of adequate available labor, says a writer in *India Rubber World* (70:2, 2 pp.), who discusses the possibility of raising rubber in the Philippines. Various South American countries within a few days' sailing distance from New York provide sufficient suitable land with the required high temperature and well distributed heavy rainfall for growing rubber, but are so sparsely populated that coolie labor would have to be imported at great expense and difficulty. Much the same is true of the Philippines, where rubber might be grown under the American flag. Only in southeastern Asia and the East Indies are the right climatic conditions and teeming populations sufficiently intelligent and industrious to be found together. And it is only from there, more especially the Dutch East Indies, that America could hope to obtain the labor and supervision necessary for operating rubber plantations capable of supplying the crude rubber requirements of the United States, wherever such plantations might be established.

Good Old-fashioned Thrift around a large industrial works is vividly illustrated by the work of the general salvage department in the Ford automobile plants. The salvage squads of this department hunt around for everything that is not used and generally termed scrap materials. They not only collect this material, but make repairs, remake and dispose of their collections at a return therefrom that runs into the astounding figure of nearly a million dollars per month. Nothing is too small to handle. They take anything from a broken mop pail to a discarded factory building. The extent of the work is indicated by the salvage department's records, which show that about 400 tons of steel trimmings are disposed of every day, while 200 tons of baled steel stampings and waste, and 150 tons of cast-iron borings are gathered up and converted into usable material. Other items in the daily clean-up include about ten tons of waste paper, three tons of factory sweepings, two to eight tons of baled tin, hoops and wire, etc. About $1,000 worth of belting is reclaimed every day for use again or made up into leather aprons, mitts, and hand pads, or into gaskets and cup washers for pumps and the like. Repairs to broken tools run into a saving of nearly $700 per day and something like 2000 gallons of oil per day are returned for reuse from passing steel turnings through centrifugal wringers.—*Industrial Eng.*

New Development in Metal-Cutting Torches.—One of the greatest advances in the art of oxy-acetylene cutting apparatus has been recently perfected by a Baltimore, Md., manufacturer. This is the perfection of a "super-tip" for metal cutting torches which, while embodying all the desirable features of the standard tip, has additional features which mark it as a signal improvement. The distinctive features of this tip are a method of super-mixing the gases and preheating the cutting oxygen as well as giving added velocity and penetration to the preheating and cutting jets. A further feature is that the tip is provided with a renewable seat at a fraction of the cost of a complete tip, rendering it unnecessary to remachine or discard the used tips. This renewable seat facilitates the cleaning and maintenance of the tip. In the standard tip the seat could be refaced by taking a thin cut off of it in a high speed lathe, but if the lathe is not available the seat cannot as readily be refaced. The mixture of the preheating gases takes place in multiple passages in the renewable seat. These gases then pass into an annular passage where they are given a swirling motion and an additional mixing. The gases are again separated and expanded into enlarged multiple passages leading to the orifices in the tip proper. Here the preheating flames are projected with an increased velocity inclined toward the high pressure oxygen jet resulting in a speedier cut, a narrower kerf and a material saving in gases.

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Mechanical Engineering

Is the New Employee or the Old and Experienced One the More Likely to Suffer from Accidents? is a question frequently asked at safety meetings. Statistics covering three 3-year periods, 1890-92, 1900-02, and 1910-12, taken from the report of the Registrar General, Great Britain, show that accidental deaths are not only more frequent among the older miners employed in the mines, but fatalities are likewise more frequent among the older men engaged in other industries than mining. The latter fact is rather more surprising than the former, because older men, being less active and presumably, leading a more quiet mode of life, might be expected to meet with fewer hazards, considering all occupations. It is probable, however, that this factor is more than counterbalanced by the lesser degree of alertness of the older men. Statistics made by Karl Marbe, professor in the University of Würzburg, in an effort to support his hypothesis that a man's liability to accident can be measured by the number of accidents he has already experienced show that a man who has had an accident in his first five-year period is nearly twice as likely as a man who had no accident in the first five years to have an accident in his second five-year period. A man who had more than one accident in the first five years is more than 2½ times as liable to accident in the second five years as the man who had no accident in the first five years.—*Coal Age*, 25:26, 2 pp.

Pipe Insulation for New High Steam Temperatures.—During the past few years there has been a tendency among engineers to use higher and higher steam temperatures. The reason for this is to raise the over all efficiency of the plant. This has made it necessary to develop a pipe insulation which will withstand temperatures of 750 degrees Fahrenheit and above. It is a known fact that most insulating materials which were entirely satisfactory for temperatures of 500 to 600 degrees Fahrenheit cannot be used economically or with satisfaction at temperatures much in excess of the higher figure. There has been produced what is termed the blue asbestos blanket or mattress, which is particularly desirable where frequent removal of insulation may be necessary. Trials made from this fiber show a good tensile strength. The specific volume of the material when fiberized is 25 per cent greater than the equal quality in white asbestos, weight for weight. Acids, alkali, sea-water and steam have no detrimental effects upon it. These blankets or mats are constructed of two layers of 100 per cent pure blue asbestos cloth, filled with long, light, well-prepared, resilient, blue asbestos fiber and sewn around with 100 per cent pure blue asbestos sewing twine, stitched at close intervals to prevent the fiber from shifting. The thickness is regulated to suit the job. The mats are prepared in but few sections to facilitate easy and quick handling whenever an inspection of the objects so covered has to be undertaken at short notice.—*Power Plant Eng.*, 28:13, 2 pp.

Metallurgy

Chrome-Vanadium Steels and chrome-vanadium-molybdenum steel are the latest developments in structural alloy steels that have gained an extensive market. Almost all these steels are made in the open-hearth furnace, chromium and vanadium alloys being added shortly before casting. In their physical properties these steels are much like chrome-nickel steels, but they have a greater contraction of area. Most of the chromium-vanadium steels made go into automobiles. Some manufacturers prefer them because of their greater freedom from the surface imperfections—notably seams—which the steels containing nickel are likely to have.—*Machinery*.

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the cans or drums in which it was packed. An investigation of the cause of these explosions shows that oxygen is evolved from bleaching powder under ordinary commercial conditions in 12-ounce cans and larger air-tight packages, in quantities sufficient to produce serious explosions. This evolution is caused by oxide of iron with manganese oxides as accelerators, acting upon calcium hypochlorite, calcium chlorate, and perhaps calcium perchlorate.—*Ind. and Eng. Chem.*, 16:6, 2 pp.

Rustless Iron should not be confused with rustless steel, about which there has been much recent discussion. In reply to a question put them by *Iron Age* the leading British producer of rustless iron states that this is a difficult metal to make in any form, and only firms with the most up-to-date and suitable plant, and the most highly skilled metallurgists, can succeed in producing it in such form that it will live up to its name. This firm has had much success in the production of bars, sheets, etc., and looks forward to a good trade in rustless iron castings. Rustless iron differs from stainless steel in that it requires no heat treatment to bring out its rustless properties. This treatment is the stumbling block which prevents a much larger use being made of rustless steel, and which practically prevents rustless steel castings being made with success. With rustless iron, all that is needed is a good polished surface. They claim not only to have succeeded in making rustless iron castings, but state that the castings they make are rustless in their cast state—a distinct advance on anything that has been done hitherto.

Increasing Use of Nickel in brass and white metal is receiving considerable attention in the brass foundry business. The comparatively recent use of this element is not surprising, for it was in 1886 that nickel-steel first was described in technical papers. Nickel as a metal is familiar to the general public because of its extensive use in nickel-plated ware, but few realize that only five per cent of the total production of nickel is used for such a purpose. Nickel is used in making several types of castings that come in contact with superheated steam. This development has taken place within the past few years, and it has been found that mixtures containing nickel from 8 to 10 per cent, with a tin content ranging between 6 per cent and 10 per cent, remainder copper, are the best mixtures to use for this class of work. This type of mixture is termed "nickel-bronze." Nickel now is playing an important part in the aluminum alloy field. The principal advantages in this respect is that from one to three per cent nickel densifies the structure, producing a fine surface which is more capable of taking a high polish and holding the luster for a considerable time. It has been found that small percentages of nickel added to aluminum mixtures containing magnesium and manganese respond readily to heat treatment and has a noticeable effect in increasing tensile strength as well as the toughness.—*The Foundry.*

The Inflammability of Magnesium Castings is altogether lower than is generally believed, says a writer in *The Foundry* (52:3, 4 pp., ill.) It is unfortunate that magnesium is familiar to the world at large chiefly in the form of powder and thin ribbon which readily is ignited. The idea this implies, that magnesium alloys are in grave danger of being set afire with ease, is incorrect. Two conditions are necessary for the rapid burning of magnesium. The first of these is that the metal must be at a temperature at least as high as its melting point. Secondly, that the metal must be supplied with plenty of oxygen. Obviously these conditions readily can be fulfilled in the case of magnesium ribbon. A match applied to the end of the thin strip supplies sufficient heat to cause a little of the metal to melt, while, owing to its elongated shape there is a free access of air. This causes the rapid burning of the metal accompanied by the well known white light and great heat. The heat developed is more than sufficient to melt the adjacent piece of the strip which in burning liberates yet more heat; and so on. It is obvious that these conditions are not so easily complied with in the case of a casting. In the first place, magnesium is a singularly good conductor of heat, so that great heat supplied at one spot tends to be distributed quickly throughout the mass of the casting. Moreover, if an intense local heating causes one portion of the solid mass of the metal to melt, the crust of oxide formed by the burning tends to prevent oxygen from reaching the metal behind it; apart from the fact that the heat developed by the burning of the small spot is rapidly conducted throughout the mass of the casting.

Metallic Chromium of a high degree of purity is now being made in the electric furnace. Probably its most important uses are in the manufacture of chromium wire and as an anode in chromium plating. The fact that it has just about the same coefficient of expansion as platinum makes it an excellent substitute for the latter metal for sealing into glass for contact with the interior of vacuum tubes or incandescent lamps. Malleable chromium wire is now being made as a result of the researches of Dr. E. R. Richardson of the Westinghouse Company. This malleable wire is made by chromium plating a copper wire, drawing down, replating, redrawing, and repeating these operations until the copper core is of a negligible cross-section. Chromium which has been electrolytically desposited, though hard, is malleable, while chromium as most of us have seen it is an exceedingly brittle substance. The principal reason for that brittleness is the very high temperature at which cast chromium has always been produced, a long time at a high temperature being conducive to grain growth and consequent weakness. A contributory reason is the presence of occluded gas and oxide. By means of the carbon resistance furnace chromium can now be cast so as to be fairly malleable.—*Chem. and Metall. Eng.*, 30:4, 4 pp.

Rustproof Iron is not yet as well known as stainless steel, because it has not been on the market in any considerable quantity for so long a time. Only recently has it become possible to produce this metal with facility on a commercial scale, because ferrochrome with a very low carbon content is necessary for its manufacture. The development of ferrochrome has only lately reached that point where the manufacture of rustproof iron can truthfully be called a commercial success. Rustproof iron is tough but very ductile and consequently can be cold worked and otherwise handled like a mild steel. The importance of this should not be overlooked. It means that it can be rolled into sheets, drawn into wire or seamless tubing, and pressed into sheet metal hollow ware of various forms. It is easily forged and readily machined. In contrast to stainless steel, it has an excellent resistance to corrosion in the manufactured condition without further heat-treatment. The uses of rustproof iron have until recently been somewhat limited by its high price, but already it is an important competitor of copper for roofing and similar applications. —*Chem. and Metall. Eng.*, 30:4.

A Very Interesting Bearing Metal Alloy has been developed by a motor company. It is a metal which can be used for bearings or bushings without the necessity of the usual amount of oil being present. Its chief characteristic is the fact that it can absorb lubricating oil to the extent of about 25 per cent of its volume. In other words, it acts similar to a spongy material so that oil is constantly present when it is functioning in an automobile or similar apparatus. The method of manufacture of this alloy is unique. Instead of being produced by melting a few metals into an alloy and then pouring off the resulting mixture, either into the final form or into some intermediate product from which the final bearing or bushing is made, powdered metals are used and the product made largely by compression. A mixture of 90 per cent powdered copper and 10 per cent powdered tin is suitable, and when put under heavy compression these two metals alloy, practically by diffusion in the solid state, so that the resulting product resembles in several respects a bronze alloy and is in truth an alloy of copper and tin. It has, however, the unusual property of absorbing and holding oil and can be used after it has assimilated the oil for a long time without any further supply for lubrication and with no harm to the mechanism. The production of this alloy is considered an unusual example of the ability of certain metals to unite by diffusion instead of by melting by means of heat.—*Brass World.*

A New Process for the production of sponge iron has been developed by the Department of the Interior, in cooperation with the University of Washington. Sponge iron, because of its porous structure and consequent exposure to an extremely large surface of metallic iron, is especially adaptable to the precipitation of copper, lead, and other metals from their solution. The development of a process by which sponge iron

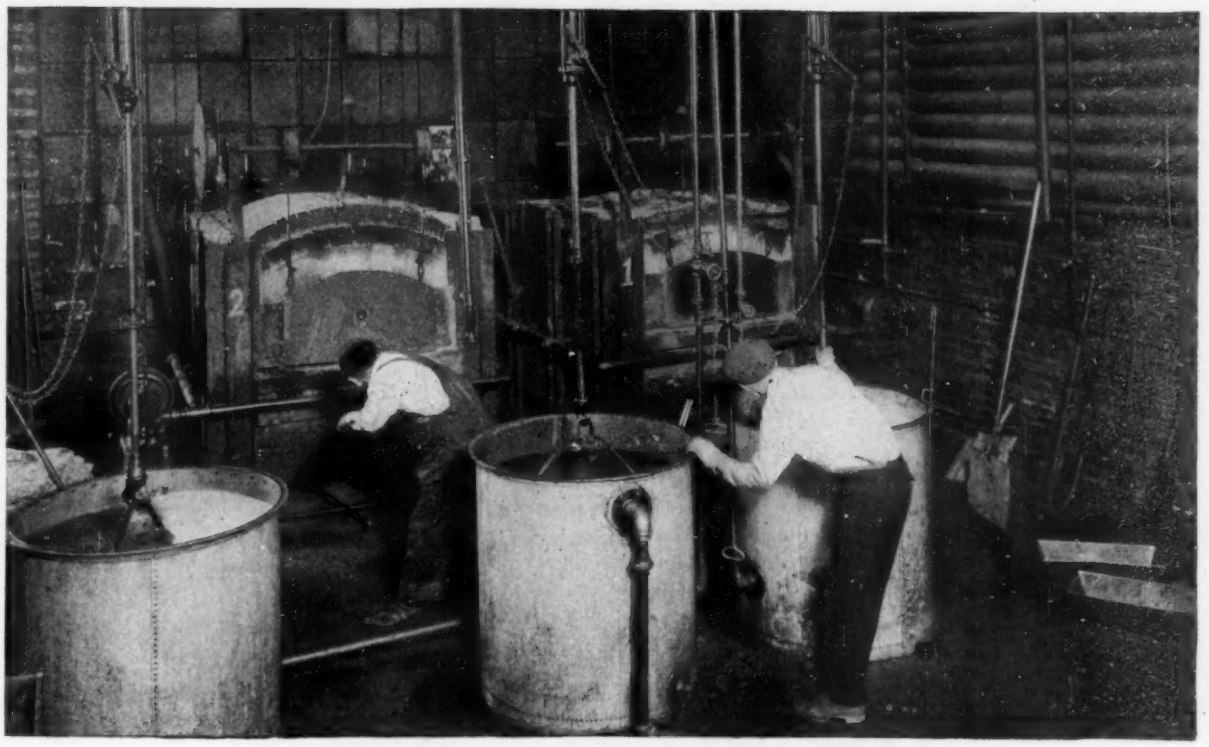
may be made cheaply from iron ore and low-grade coal and afterwards converted into iron and steel products by treatment in the electric furnace would be of especial economic importance to the Pacific coast region of the United States, a territory remote from the larger iron and steel producing centers, but endowed with cheap electric energy to take the place of the expensive coke that would otherwise have to be utilized in iron and steel production. On account of the removal of oxygen from iron oxide ore, the structure of sponge iron is very porous, an extremely large surface of metallic iron being exposed. As a result, sponge iron is an active reducing agent and precipitates metals from solution with greater speed than do the more massive forms of iron, such as steel scrap and iron turnings. The Bureau of Mines considers that sponge iron will probably be used extensively for the precipitation of copper, lead, and other metals from hydrometallurgical solutions.—*Brass World.*

Growth of Gray Iron.—Gray cast iron may be defined as an alloy of iron and carbide of iron, with minor other metals and metalloids, holding graphitic carbon in suspension. The metal itself takes up a reasonable volume of occluded gas in the process of solidification, and this also is the case to a marked degree in the formation of graphite in contact with metals, as has been demonstrated by Moissan. It is now definitely agreed that the elements silicon and carbon, and the occluded gases to a somewhat larger degree, are the most important factors in the phenomenon of growth in gray iron.—*Foundry*, 52:7, 2 pp.

Processes for Reducing Iron Ore Electrically have been going through a progressive development for a number of years. In North America this work is comparatively recent, the efforts to reduce domestic ores, in various parts of the United States and Canada dating from 1907. Establishing electric iron smelting plants in the United States has been handicapped by many factors. Most of the plants have been built close to power, or to the smelting materials and far from consuming markets for the product. The early development of the electric reduction process was experimental and no financial returns were realized by those interested. The dependability of buying pig iron from established blast furnace operators, and the inability of the electric furnace operators to assure a uniform product, made it difficult to establish faith in the process among users of pig iron. At the present time the electrothermic reduction process is established metallurgically, but it is not sure of its position commercially.—*Iron Trade.*

America Leads in Electric Brass Melting.—In the electric brass-melting field the United States has attained a tremendous lead over all foreign countries, according to a report just made public by the Department of the Interior through the Bureau of Mines. Whereas in the United States there are about 540 active electric furnaces doing commercial non-ferrous melting, it is doubtful whether all foreign countries combined use 100 electric brass furnaces. Of the American furnaces, about 275 are induction furnaces, about 135 are moving indirect arc furnaces, 80 are Baily furnaces, while the remaining 50 furnaces are of various types. The possibilities and limitations of the electric brass furnace are becoming better understood, the Bureau of Mines declares. The increase in the number of furnaces installed indicates that the growth is likely to continue, and that the electric furnace is of decided use to the non-ferrous metal industry. No radically new types of electric brass furnaces have been introduced in the United States in the last two years. The outstanding developments are the continued increase in the use of the induction and the rocking-arc types, and the lack of increase of less efficient types such as the granular-resistor and the muffled-arc types. The popularity of the two chief types has been attained because both are efficient, both give lower metal losses than fuel-fired furnaces, and both stir the metal so as to give perfect mixing.

What Is Hardness, Anyway?—A particularly fascinating problem is engaging the attention of a technical committee with which we are in close touch, says *Chem. and Met. Eng.* It is an attempt to derive from the results of various hardness tests a figure that is a direct measure of a given utility of the metal tested. "Hardness" means so many things that it means nothing in particular. Each of the hardness-testing machines on the market measures a different



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quality of the metal. Each of these qualities is a combination of several fundamental properties, but seldom is it the combination in which the user is most interested. For this reason a hardness test usually gives, not a direct measure of the desired quality, but another figure which, while useful, is only a makeshift. One type of machine measures a quality that may be called "deformation hardness;" a second measures "penetration hardness;" a third "flow hardness;" a fourth, "rebound hardness." The most promising at present is the construction of an empirical equation and the application of the "cut and try" method, and until more is known of the fundamentals of mechanical strain in a metal this method will be followed.

Hard Spots that had been the source of trouble in machining permanent mold pistons for the Curtiss D-12 airplane engines were found to be largely oxides of iron. The source of the inclusions may be the hardener used to introduce the iron into the alloy or scale from stirring rods, and melting pots. Experiments to determine the metallographic structure of aluminum alloys containing oxides and nitrides of aluminum failed to reveal the identity of these constituents, if present, in alloys melted under conditions favorable for their formation. The effect on the mechanical properties of oxidizing the molten alloys was negligible. Several pistons for the Curtiss D-12 engine which had been rejected on account of hard spots were used for this investigation. These pistons were cast in the following alloy: Aluminum, 88.32; copper, 10; iron, 1.25; magnesium, 0.25; impurities 0.11 per cent. Hard spots in ferrous and non-ferrous castings are a source of trouble in the machine shop. The castings are hard to machine, and damage to the tools results. Such castings frequently have to be scrapped as unworkable. This retards production and increases costs. The cause of such conditions is a subject of much discussion, and experimental work has been done in an endeavor to ascertain the cause, and if possible overcome the effect.—*The Foundry*, 52:10, 1 p.

New Method of Making Nickel Steel.—It has been found that it is possible to produce a good grade of nickel steel, by using impure nickel oxide containing large quantities of iron oxide instead of metallic nickel. The use of metallic nickel is sure but expensive and as the nickel-steel can be made in a single melt using nickel oxide, the latter process is cheaper. The raw products used in the production of nickel steel may be roasted nickel matte, roasted nickel speiss or mill scale, of which three-tenths per cent may consist of iron and nickel oxides.—*Can. Min. Jour.*

Mining

The First Approval of a Portable Electric Power Plant for Use in Gaseous Mines has been given by the Department of the Interior, through the Bureau of Mines, and covers a special locomotive type truck containing battery cells of sufficient number and capacity to operate a coal cutting outfit. One of the chief sources of electrical accidents in coal mines is sparking or arcing of the electric wiring. A wide application of the storage battery may be the solution of this problem by doing away with all permanent wiring in gaseous or dusty mines. The advantages claimed for the portable power plant are that it permits the elimination of feeder circuits and that it gives more rapid and satisfactory operation of the mining machine owing to uninterrupted power supply and non-fluctuating voltage conditions.

The Only Commercial Occurrence of Andalusite that is now known occurs at an elevation of 10,000 feet on the slope of White Mountain, in Mono County, California, states W. M. Myers, assistant mineral technologist, of the Bureau of Mines. The ore reserves are probably enormous. The andalusite occurs in massive form, and is so pure that no treatment other than crushing is necessary. Andalusite is an aluminum silicate which, when fired at a very high temperature, changes its crystallographic properties and inverts to sillimanite. It has been known for some time that porcelain and chinaware bodies contained considerable quantities of a crystalline substance which when examined with the petrographic microscope was found to correspond in nearly all respects with the mineral sillimanite. As these porcelain bodies are made by firing a mixture of different clays, silica and feldspar in a kiln, this sillimanite might be called a synthetic product. It has

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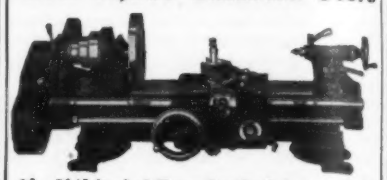

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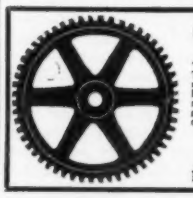

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recently been reported that the crystals which have been called artificial sillimanite, although very similar to natural sillimanite optically and crystallographically, have not the composition of sillimanite. Ceramic research by the Bureau of Standards demonstrated that porcelain bodies containing very high percentages of this artificial sillimanite were very superior in many respects as they possessed great tensile strength, high di-electric properties, and low thermal expansion, which made them superior to previously known porcelains for electrical purposes and particularly for spark plugs for motor ignition. The high tensile strength and accompanying resistance to deterioration caused by vibration, together with high di-electric strength, made these sillimanite bodies ideal material for the manufacture of spark plugs.

Freezing the Soil is the method used in mining in a highly valuable coal basin recently discovered in the northern part of Belgium. The formation will probably attain a thickness of 9800 feet, and includes 46 beds of coal having a total thickness of 118 feet. Unfortunately, the rich portions are found to be covered by stagnant marshes, the thickness of which varies from 1509 feet in the eastern part of Belgium to 2263 feet in the actually prospected western portion. This makes it difficult to develop this coal basin, for any shaft that may be sunk must penetrate these great thicknesses of marshland, which consist for the most part of sand and wet marl. It has been possible, however, to overcome these difficulties by means of the freezing process, which consists in isolating a portion of the strata from the mass of surrounding marsh by means of an ice wall of approximately cylindrical form. In the center of this cylinder a shaft protected by the wall of ice is excavated. To form this wall a number of bore holes about three feet apart are drilled on the circumference of a circle concentric with, and of larger diameter than, the shaft to be dug. In each of these holes is lowered a vertical pipe sealed at the lower end. In this an extremely cold solution of salt is circulated. Around each pipe a frozen zone is formed that continues to widen until it unites with the frozen zones of the two adjoining pipes. —*Coal Age*, 25 :23, 4 pp., ill.

The Price of Radium remained for some time from $100 to $120 per milligram. Then came a sudden decline to $70 per milligram, this reduction following a discovery of ore of unusual richness in the Belgian Congo. Two deposits have been found about 80 miles apart and 75 ton lots of ore from them have averaged as high as 85 per cent uranium oxide. Specimens running above 87 per cent are not unique. This means that the ore runs approximately four and one-half tons per gram of radium and, according to our information, the Belgian plants commonly produce a gram of radium for each nine tons of ore treated. When this is compared with the average of 400 tons of ore treated to one gram of radium produced by one of the leading chemical companies in America, and approximately 250 tons per gram of radium produced in the government works near Denver, some conception of the influence upon the radium market and the possibilities may be derived. This African ore is not only phenomenally rich, but is free from some of the substances that ordinarily interfere with radium purification. It is even estimated that, with ore of this character and grade, the cost including overhead does not exceed $5 per milligram. The $70 per milligram is the figure which was calculated to stop operations of American companies and has succeeded in doing so.—*Ind. and Eng. Chem.*

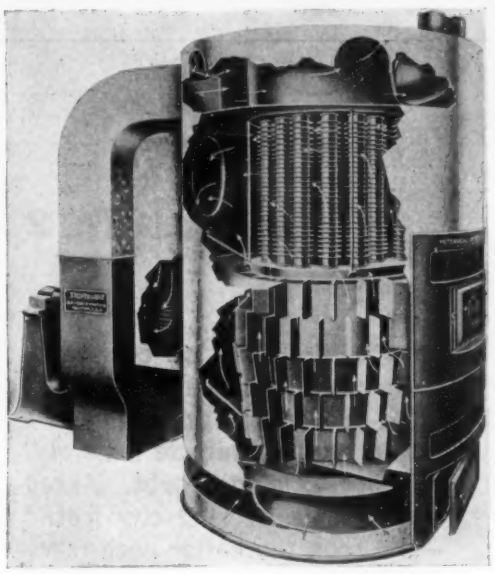
Oil from Shale in 1944.—The United States holds the premier position among all nations in that it has both an enormous supply of well oil and also the greatest supply of oil shale in the world. The joint committee of the U. S. Geological Survey and the Association of Petroleum Technologists, after a careful survey and analysis of the subject, estimated that 9,500,000,000 barrels of oil remained in the ground recoverable by present methods and that this supply would last approximately for 20 years. It is not to be assumed that this supply would be suddenly stopped; rather would the supply gradually diminish, increased intermittently by the discovery of new pools. At the same time there would be a gradual increase in the price of crude oil and its derivatives, such as gasoline and lubricating oils. When this price increased to the point where substitutes could be obtained, they would appear. The one great substitute for well oil is oil from shale, not to supplant well oil but to supplement it. The records of well oil production show that the United States is the greatest oil producer in the world. We have made a careful study of the oil shale deposits in all other countries and can state, without any qualifying reserves whatever, that the United States has the most extensive, the richest, and the most accessible oil shale deposits in the world.—*Combustion*, 11 :1, 5 pp.

The Average Mining Engineer, says *Eng. and Min. Jour.*, if asked to name the district that has produced the most silver, usually thinks of Cobalt, or the Comstock district, though he feels that possibly some of the Mexican or South American camps may have been greater producers if one goes far enough back into history. As a matter of fact, they have produced considerably more, according to figures recently published in *The Financial Post.* The largest producer is the Potosi, Bolivia, locality with 30,000 metric tons of silver. Then comes Guanajuato, Mexico, with 15,000 tons; Zacatecas, Mexico, 14,000 tons; while Cobalt, not a tenth the age of these camps, stands fourth with 10,000 tons. Comstock, Nevada, produced only about 5000 tons. Of course, the Mexican camps named have been producing for some 300-odd years.

A New Surprise Has Been Produced by South Africa, the land of mineral wonders. What promises to be the most important discovery of lode platinum ever recorded has been made by a prospector in the Transvaal. During a long period of years of tin mining the quartz lode in which platinum has now been found stood up boldly above the surrounding country, a familiar object to prospectors and geologists. Recently, Adolph Erasmus, a grub-staked prospector, determined to wash some gravel in the vicinity; and, starting with an ant-heap, found not only flakes of gold but of a gray metal which lagged behind the gold in the pan. From this behavior he jumped to the conclusion that it must be heavier than gold—and therefore platinum. This surmise proved to be correct, and the platinum was traced to the quartz lode. It is anticipated, says *Eng. and Min. Jour.-Press*, that the South African platinum production will be sufficient to lower the present high prices of about £23 to about £15, but not lower.

Cushioned Blasting with rock-dust stemming is a comparatively new way to get more results from a given amount of explosive. With rock-dust as stemming, the maximum cushioned effect is secured, and the tamping operation is even simpler than present practice. The procedure, in brief, consists in placing one or more cartridges of finely-ground rock dust in the hole after the reduced explosives charge has been loaded. The explosives cartridges should not be slit or tamped, and the long cartridges of rock-dust stemming are merely shoved into the hole without tamping. It was found in the Ruhr mines that the explosion compresses the rock dust and wedges it tightly in the mouth of the hole so that none of the gases can escape until they have done their work in bringing down the coal. If, by any chance, a blown-out shot occurs, the rock-dust stemming helps to quench the flame. It is, therefore, a safety precaution, whereas coal dust frequently used for stemming is a real danger, and clay, though not a menace, has no flame-quenching properties. The compression of the rock-dust stemming by forming a long pressure chamber provides a greater area against which the gases can expand.—*Explosives Eng.*

A New Blasting Cap has within the last three years been brought into mining use. It has been the endeavor of explosives' chemists for the past 20 years to harness lead azide in commercial form, but, owing to the extreme difficulties of stabilizing this compound their efforts were not successful until three or four years ago. This difficulty has now been entirely overcome. Lead azide is lead-trinitride (PbN_6) but although this by itself was formerly a dangerous compound, it has now been rendered safer than the ordinary fulminate of mercury hitherto known to mining, by the addition of a secret nitro-body known as tricinate. Long research has proved that it is impossible to load this substance into a copper tube, but the important discovery was made a few years ago that aluminum was in no way whatever affected. Simple although it may appear the aluminum plays an important part in the general efficiency of the cap for, on detonation, the aluminum is entirely burned up adding greatly to the heat of combustion,



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and the consequent initial velocity of the cap. The aluminum tube being softer than copper, it is possible to secure a watertight joint between the cap and the safety fuze by efficient crimping without the aid of grease or pitch. One of the remarkable features of this new cap is its moisture resisting qualities and in point of fact it is practically waterproof. This has been proved time and again by various experiments and these caps have actually been immersed in water for a period of days, and then taken out and immediately fired without their efficiency being in the slightest degree impaired. In addition to the foregoing features the "brisance" of the new cap is such that its use results in a considerably greater efficiency in detonating the main explosives charge; and this has been clearly proved by means of the Aesop test, which is now recognized as the standard for such experiments. These aluminum detonators have now been in use in the Witwatersrand (Johannesburg) mines for the past 18 months and are far more largely used than any other type.—*Can. Min. Jour.*

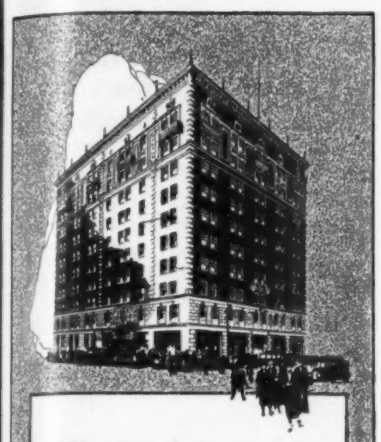
Hallmarking the Coal Pile.—Having the government certify the coal is an excellent idea set forth in *Coal Age*. When the goldsmith craftsmen of Great Britain found their product looked upon with suspicion because some of the dishonest workmen put excessive quantities of dross in the gold, they arranged to have their guild assay all gold and put a stamp upon it to show how much dross was mixed with it. Some time ago O. P. Hood, mechanical engineer of the U. S. Bureau of Mines, advocated that any company that requested the Bureau so to act should have the product in several of its cars in various parts of the country sampled at random. The Bureau would not take samples in cars indicated by the operator but take its own pick of all the cars shipped. It would then determine by this investigation the rating of the mine from which the cars came, that rating being above or below a correct rate of the coal in the face of the mine according to the degree of cleaning. The mine would be permitted to sell the coal as being of a quality vouched for by the government, but should it prove in analyses of samples taken frequently thereafter that the rating should be lower or higher, a new rating would be issued, and the mine, whether it wished or not, would be obliged so long as it quoted the government approval to announce its rating so that all the world would know if the coal from that time was 12, 14 or 18 carat, so to speak. This refers to bituminous coal. Homeowners will wish that it referred also to anthracite.

Hexamethylenetriperoxidiamine.—This is not a puzzle—it is the name of a new detonating compound being investigated by the United States Bureau of Mines. Exposure of specimens of this material to saturated air up to one month caused no change. It was then kept under water for one month without change. As a detonator it is less sensitive than fulminate, which requires one-half cm. on the small impact apparatus whereas hexamethylenetriperoxidiamine requires three cm. Hence it may be useful in armor-piercing shell. Commercially it may also find use because, while it costs twice as much as fulminate, only one-third is required for equal work. The fulminate deteriorates and causes misfires when exposed to moisture, which is a disadvantage, although the technique of preparing and using fulminate detonators is developed to a point where troubles for moisture are practically nil. Tests to determine its tendency to hydrolyze show that it is stable at ordinary temperatures both when kept under water and in a saturated atmosphere. Experiments showed that it would not become "dead pressed" under a pressure of 11,000 pounds per square inch, while mercury fulminate only burns after that pressure.—*Can. Min. Jour.*

A Snag in Oil-Shale Developments.—Any engineer making a trip through the oil-shale region of the Rocky Mountain country will be struck by the fact that the water-supply problem will have to be solved before an oil-shale industry of any considerable size can be started there, the Bureau of Mines points out in Technical Paper 324. The situation does not appear so serious to those who do not travel far from the main streams or arteries of travel, although even in these places it may cause thought. Only when one gets away from the railroads—and often that means visiting the richer shale deposits—does the magnitude of the water-supply problem become fully evident. There are few large watercourses, and these are generally far apart. Many of the smaller tributaries are periodic; they may be entirely dry part of the year but roaring torrents during the rainy months. Little is known as to possibilities of obtaining adequate water supplies by well drilling, but in many places the prospects do not look very favorable. At the present stage of the shale industry in this country it is almost impossible to state definitely the amount of water required for large-scale operations. The amount required for mining and crushing the shale will probably be similar to that in the coal-mining industry where similar conditions exist. The per capita domestic requirements for water will vary with the location of the plant and with local conditions. The most important use for water is in retorting and refining, but the amount that will be required for these purposes is more in doubt than that for power or domestic use. Shale retorting and refining plants will require water, whether or not the retorts are steamed. Large quantities of water will be needed for power, mining, and domestic uses. The oil vapors must be condensed, and distillates treated, and the fixed gases scrubbed; and in other stages of retorting and refining there are many uses for water. Yet even now, large oil-shale plants are being proposed in regions where the water requirements, if only for mining and domestic use, will present a problem that may require the expenditure of considerable technical ability and capital for ultimate solution.

A Study of the Distribution of Air in Metal-Mine Ventilation with especial reference to flexible tubing methods, made by D. Harrington, supervising mining engineer, Department of the Interior, are summarized in Serial 2551, recently issued by the Bureau of Mines. "Blind ends" include most of the working faces in metal mines and, in general, they are unventilated except that a limited amount of compressed air is liberated during part of the working shift. These unventilated "blind ends" constitute by far the greater proportion of the places in metal mines at which the workers encounter the unhealthful conditions which cause so much more disease among metal than among coal miners. Use of flexible tubes with small blowers furnishes probably the most efficient and most economical method to date for ventilating "blind ends." By flexible tubing methods quantities from 1000 to 5000 cubic feet of air per minute are readily released at face of "blind ends" up to or even over 2000 feet from circulating air. Velocity of air at release end of these flexible tubes is from several hundred to four or five thousand lineal feet per minute. Places with hot rock or water (80 degrees Fahrenheit or over) quickly give that temperature to air without circulation, but when flexible tubing is used and outside air supplied, air temperatures at working faces are readily reduced 10 to 20 or more degrees Fahrenheit. It has been found by investigators of that even when air is practically saturated with moisture and with temperature up to 90 degrees Fahrenheit, the giving of velocity of a few hundred feet per minute allows of performance of work with little or no unfavorable effect, while working in stagnant air above 80 degrees Fahrenheit has definite ill effect especially on body temperature and pulse beat, and to a less extent on blood pressure. Hence for such places the use of flexible tubing is of decided benefit. Investigators in South Africa found that merely by giving of movement of a few hundred feet per minute to practically saturated air in which native laborers were working, air temperature being about 87 degrees Fahrenheit, the men delivered about 45 per cent more work than in stagnant air yet did not know of the change in conditions or that they were working more vigorously.

What Is the Biggest Nugget?—What is the biggest nugget on record of silver or gold? Not so long ago a 3200-pound mass, assaying 8000 ounces silver a ton, was marketed by Anton Clement. It came from his claims in the Gillies Limit, Cobalt district, Ontario. The largest nugget or isolated chunk of pure or nearly pure silver on record is a mass weighing 1750 kg., or 3850 pounds, or 1.9 short tons. It would contain 36,146 fine ounces troy if pure. It was reported in 1907 as having come from the Gibson mine, at Aspen, Colo. Really, however, the record seems to be a mass of 18 metric tons, or 39,600 pounds avoirdupois, that came from the Calaverita mine, in eastern Durango, Mexico. It ran 75 per cent silver, and was so nearly pure metallic silver (which is noted for its soft ductility and malleability) that it couldn't be blasted, hammered, or broken. It had to be cut with knives and saws.—*Eng. and Min. Jour-Press.*



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A New and More Accurate Survey of Hidden Ore Bodies is afforded by the Kiruna method, described at length in *Eng. and Min. Jour.-Press* (117:17, 4 pp., ill.). In the same proportion as diamond drilling has gained extensive use, the efforts to determine the actual course of the drill holes have increased. It has been proved that deep drill holes can deviate considerably from their intended directions, a fact that in many cases may have a decisive influence on the interpretation of the drilling result gained. If a cylindrical tube partly filled with liquid is let down into a drill hole, the outline of the surface of the liquid will form a circle on the cylinder wall if the hole is vertical, but an ellipse if the hole is inclined. The form of the ellipse determines the inclination angle. The great axis of the ellipse shows the direction of the drill hole at the place where the measurement is made. By means of two or more such tubes of liquid rigidly connected a certain distance apart in a hole, it is possible to find out from the form of the ellipses and the directions of their great axes both the amount and the direction of the deviation.

Rock Falls from Mine Roofs.—D. W. Rees in an article in the *Colliery Guardian*, Vol. CXXV., p. 331, explains that the earth tilts on an average twice a day and in winter sometimes more often. That tilting is only about one-thirtieth of a second of arc but this, though intrinsically small, corresponds to a vertical movement of the strata of about 60 feet. The figure given is often exceeded, however. One or two hours after midday or midnight is the most likely time to observe this effect. Mr. Rees declares that miners know as a matter of tradition that a visible and audible effect is produced at these times and that falls which are on the point of occurring are most likely to take place during those periods. He says that fine matter drops from the roof at these intervals, showing that a slight movement of the strata as a whole is taking place, a grinding noise is heard as the roof settles on the packs, and the mine seems to be moving in every part. The greatest effect over a period is produced in March and September, but weighing should proceed at a more rapid rate in winter than in summer. The author shows a chart showing the relation between the number of unassisted falls and the time of occurrence averaging over the period of one year in a seam with a weak roof. From this can be gathered that an average of 14½ occurred at about 2:30 A. M. and six about 2 P. M. These periods were the two maxima. The night maximum, though higher than the day maximum, is of a duration not in accord with its intensity. At midnight, about 0.5 falls occurred; at 2 A. M., about nine; at 2:30 A. M., as stated, about 14½; at 3 A. M., about twelve; at 4 A. M., about six; at 6 A. M., only three; at 8 A. M., less than two; at 10 A. M., a little less than one. Then starts the day maximum. At noon there are two and at 2 P. M. there are, as stated, six; at 3 P. M., about 5½; at 4 P. M., only three, and thereafter till midnight, never more than 1½; at 4 P. M., only three, and thereafter till midnight, never more than 1½ nor less than one-half.—*Coal Age.*

The Magic Prospecting Machine.—Quite a number of inquiries have been received by the SCIENTIFIC AMERICAN concerning an alleged prospecting indicator, by means of which the prospector had only to wander over the face of the earth carrying this machine in his hand and sticking in a peg wherever the device indicated a hidden fortune. It is a fact that several new prospecting methods have recently been developed which depend on indicating devices. But the belief that anyone could use them to find ready gold anywhere it exists is, to say the least, highly exaggerated. *Canadian Mining Journal* issue of April 25, 1924, describes quite systematically several new methods of locating minerals from the surface. One method is magnetic surveying, developed in Sweden. A dip needle is used; but it will indicate only magnetite and pyrrhotite. There are in addition two electrical methods of prospecting, one being based on the principle of spontaneous polarization, metallic sulfides acted on by ground waters producing an electric current; the other, called the Lunberg-Nathorst system being based on the greater electrical conductivity of sulfide ore bodies than the surrounding rock. In the first method the deposits must be quite concentrated, and one part of the deposit must be above and one below the ground water level. The ore must also be within 300 feet of the surface,

(Continued on page 218)

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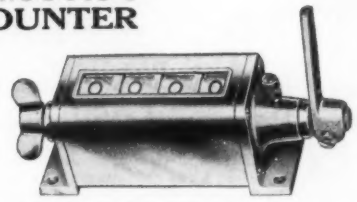

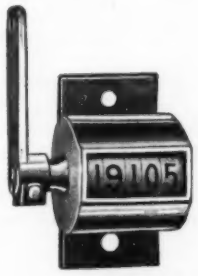

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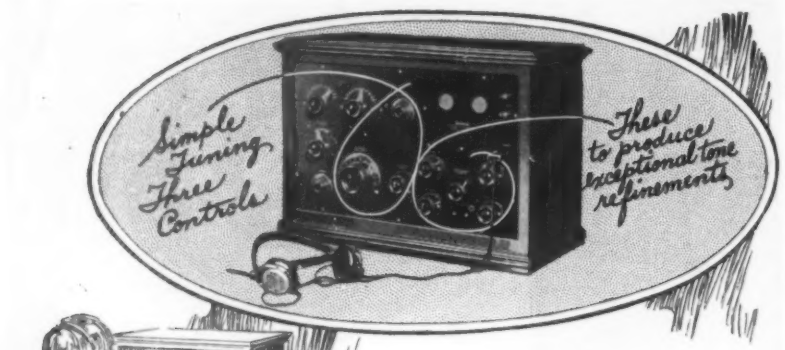

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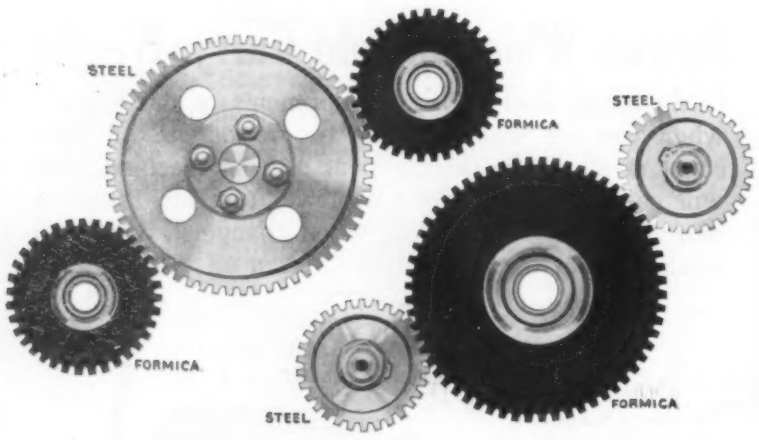

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Radio Notes

Compact Inductance Coils and Mounts are not used to the extent which their efficiency warrants. After all is said and done, these compact inductance coils, represented by the duo-lateral, honeycomb, Giblin and other windings, have a wide range of application in radio reception. Two of these coils of the proper sizes make an ideal coupler, and the addition of a third coil forms the tickler or regenerative control. These coils make an ideal tuned radio-frequency transformer. It is interesting to note to what extent these compact coils are employed in Continental practice. The advertisements of French radio manufacturers in particular seem to be saturated with all kinds of compact inductance coils and ingenious mountings provided with exceptionally long control handles so as to eliminate body capacity.

The Low Potential Tube.—Much discussion has been created in England over the new Dowding & Rogers vacuum tube, which will do away with the "B" batteries or with any other source of high potential current, according to the claims of the inventors. Hugh S. Pocock, editor of the *Wireless World*, tells us the idea is by no means revolutionary. About a year ago there was published in that British paper an article on the operation of an Armstrong super-regenerative receiver with two dry cells instead of the regular batteries. While certain interesting results were obtained, it was found that the operating efficiency of the tube was always reduced in proportion to the reduction of plate potential. All in all, there is no immediate hope of doing away with "B" batteries, although the new tubes are an interesting development.

The Pie Tin and Telephone Antenna.—Some bright individual has discovered that if a pie plate is placed under the usual desk type of telephone instrument, and that pie plate is connected with the antenna binding post of the receiving set, pretty fair reception is obtained. The telephone line acts as the antenna, and the radio energy is passed through the improvised condenser made up of the telephone instrument and the pie plate, on to the receiving instrument. The main attractiveness of this stunt is that the telephone service is not interfered with in any way, and the telephone company has no come-back whatsoever, inasmuch as no tapping of wires or tampering with the instruments has taken place. A still brighter individual has lost no time in bringing out a special pie plate especially intended for this purpose, provided with a binding post and carrying some high-sounding name, which, of course, works better than the ordinary pie plate—psychologically speaking, to be sure.

Operating Vacuum Tubes on the Lighting Current is being freely promised these days. Indeed, during the past month or two we have suddenly run into the open season for all kinds of devices to enable the usual radio set to be operated off the electric-light socket. Some of the claims made for these new devices are far from modest; if anything, they are decidedly rash. We know something of the difficulties of ironing out the ripples and taking the hum out of commercial lighting current. Some of the new devices make use of two-element rectifying tubes; others make use of large three-element tubes, using the space current of these tubes to replace the usual "B" battery. Still others use special transformers, with potentiometer adjustments and filters to kill the hum more or less effectively. So far, we have been most impressed with the thermoformer device, which makes use of the thermo-electric method of converting electric lighting current first into heat, and then translating that heat back into the desired direct-current potentials, without trace of ripples or hum.

The Future of the Vacuum Tube.—Despite its present standardized design, the three-element tube in common use is by no means the ultimate in vacuum tubes. Already there are ample signs of radical changes in the no distant future. The present triode, with its filament to boil off electrons, its plate to pull them across the vacuum and the grid to control their flow, performs such wonderful feats that it seems as though more than three electrodes in such a tube would be superfluous. Such is not the case, however. Years ago a four-electrode tube was developed in the General Electric Research Laboratory and called the pliodynatron, and now we have the five-electrode tube making its initial bow. This new tube will ultimately be developed so that it will modulate, oscillate, rectify and amplify, as

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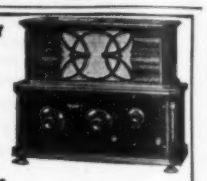

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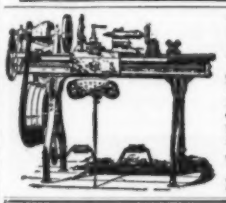

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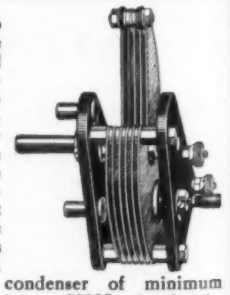

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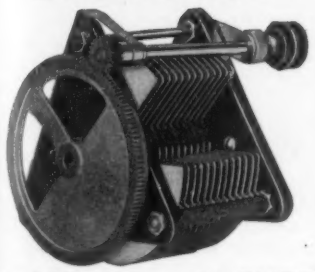

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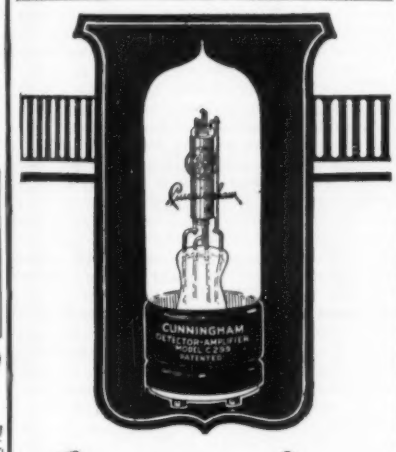

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well as perform other less common functions. Multi-electrode tubes of this general nature must eventually come into use, making it possible for a single tube to perform the same work as is now done by several tubes of the three-element kind.

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Rejuvenation of Vacuum Tubes.—When the thoriated or so-called activated filament vacuum tubes are subjected to excessive filament voltages the electronic emission may be reduced to the extent that the tube temporarily loses its sensitiveness and amplifying properties. When such a decrease in efficiency occurs, the normal sensitiveness and amplification of UV-199, UV-201-A, C-299 and C-301-A, as well as other tubes with activated filaments, can be restored by the simple process known as "reactivation," as follows: (1) Place the tube in the socket of a radio set, disconnect the plate battery and apply a voltage to the filament terminals 10 per cent in excess of the normal rated voltage. Use an accurate voltmeter for this purpose, if possible. (2) This means that 3.3 should be applied to the UV-199 and C-299 types, and 5.5 volts to the UV-201-A and UV-301-A. (3) The application of this voltage should extend over a period of from 2 to 15 hours, depending upon the extent to which the electronic emission has decreased. (4) To determine when the sensitiveness of the tube has been restored to normal the filament voltage should be reduced to normal and the tube connected in a standard radio set in the usual way. This may be done at the expiration of 5, 10, or 15 hours, and if at the end of any of these testing periods the tubes operate satisfactorily, a continuation of the reactivation process is no longer necessary.

Handling the Democratic Convention Speeches.—To bring signals of adequate volume from the Democratic National Convention at Madison Square Garden, New York City, to the antenna of WGY at Schenectady, N. Y., the sound energy picked up by the microphones in New York had to be amplified at six different points on the journey. WGY and WJZ are now connected together by a Western Union remote control wire system. In the broadcasting of the Democratic Convention by these two stations, the voice or sound was picked up by microphones in New York and amplified before being sent over the wires to the control room at WJZ. Here the signal was amplified again for the operation of the WJZ transmitter, as well as for the remote control wire service which led to the Walker Street terminal of the Western Union. Here the signal was again boosted or amplified for the third time and sent through subterranean wires to Sedgwick Avenue, where the control wires leave the New York City cable and go into an open wire line strung on poles. Here another boosting took place, giving the signals sufficient power to reach the WGY control room in Schenectady, where they received the fifth boosting to overcome the long journey over the telegraph line and were prepared for the quarter-mile journey through wires to the transmitting station. At the transmitting station the signals were again boosted for the sixth time and turned over to the radio transmitter. To assure good service to the listeners-in, this system required nine operators along the circuit, namely, one man at Madison Square Garden; one man in the WJZ control room; one man in the Walker Street terminal; two men at Sedgwick Avenue; two operators at the WGY control room, and two men at the WGY transmitting station.

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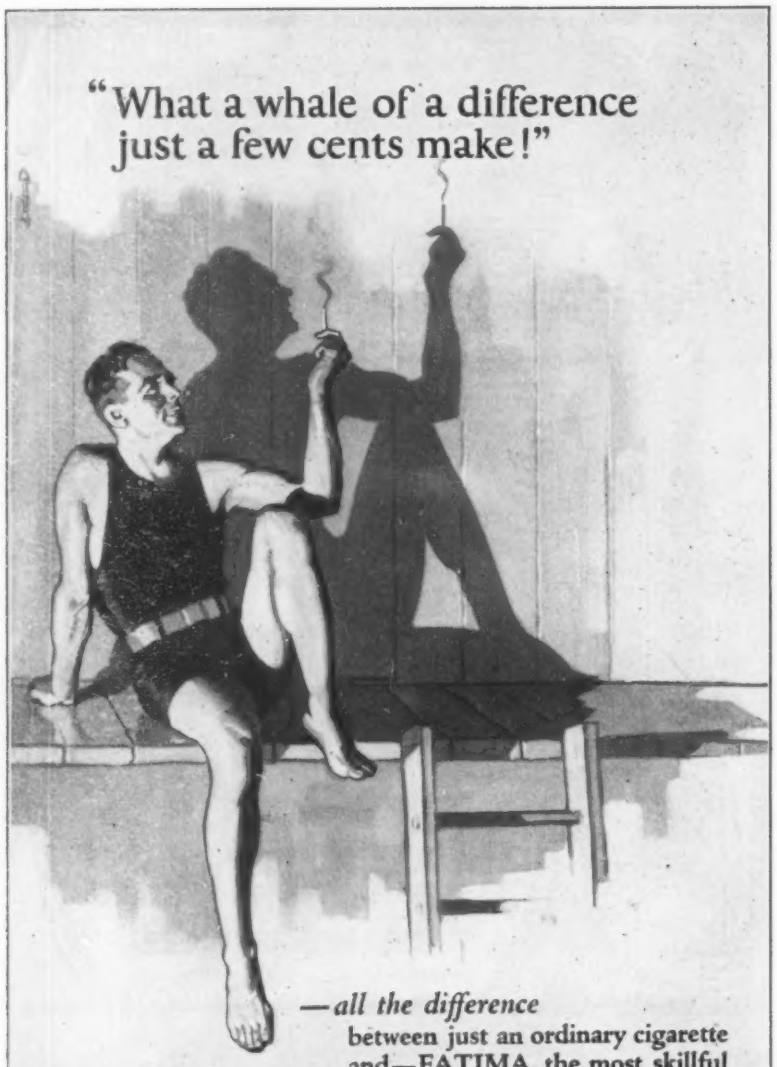

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Scientific American Digest

(*Continued from page 215*)

and both oxidizing and reducing solutions must be present. Still another method is the Eötvös Torsion balance method, which is based on the difference in specific gravity of heavy and light rocks. None of these methods is simple, all requiring much geological training and technical knowledge for their successful use. Some of them have proved quite successful, but their limitations are so great that they are not a snap method of getting rich quick. Someone is always taking the joy out of life!

Mine Timber Supply Decreasing.—Timber for mines is getting scarce. It will get still scarcer unless something is done. To find what is the best thing to do about it a discussion was held at the recent annual meeting of the American Institute of Mining and Metallurgical Engineers and it was admitted that there is no panacea or even palliative that is immediately available for the difficulties which the coal mines of the country are now facing in the way of timber supply. However, there are three well defined methods whereby the present situation may be at least partially relieved. These are: The use of less timber in mining, the preservation through chemical treatment of the timber used, and, the employment of various substitutes for timber. Probably the State of Pennsylvania has gone further towards fostering the reforestation of mining areas than has any of the others. This State now furnishes trees for planting without cost. These consist mostly of pine, larch and ash. It takes about fifteen years to produce a tree sufficiently large to make a mine prop. One of the greatest difficulties to reforestation, whether by mining companies or anyone else, is the prohibitive taxes levied by the State. In Europe, it is customary to tax reforestation areas merely a nominal sum during the growth of the trees, but to levy reasonable income taxes when the trees are cut. It is probable also that long-term loans by the banks at reasonable rates of interest would do much to foster timber growing.—*Coal Age*, 25:14, 1 p.

Mining Coal Without Explosives is one of the fondest dreams of the inventor. The various direct and indirect troubles brought about in coal mining with explosives make coal cost much more than it should, both in money and in lives. Many times in the past inventors have devised mechancial devices for breaking down the coal after it has been undercut. In most cases these have been long, thin wedges or some method of exerting high pressure by means of cartridges of slacking lime, or by the use of the hydraulic jack. One device of the latter sort is described in *Coal Age* (25:14, 2 pp., ill.). This is able to exert a pressure of five tons per square inch on the inside of a drill hole, giving a total bursting pressure of 240 tons. This consists of a long "cartridge" having a number of pistons. This connects with a handscrew by means of a small tube. A quart of water is all that is required to transfer the pressure to the series of pistons. The outer ends of the pistons exert the force against the coal and break it down. Such a device is safe against gas fires, accidental explosions and as it may be used indefinitely, it obviates the expense of buying explosives.

A New Coal Mining System called the "V system" is described in *Coal Ind.* (7:3, 4 pp., ill.). The design primarily consists of a pair of comparatively short faces arranged at an angle to each other so as to form a V, both of these faces being turned from a single entry the line of direction of which bisects the angle of the V. Two or more of these pairs are connected in parallel and form a double or multiple V arrangement. In mining, machine cuts are taken along the faces so that the central angle remains constant and the points stay in line; and as mining progresses, the faces retreat and assume the successive positions shown by the dotted lines. The fundamental idea of this design is to give maximum protection to the working faces by supporting the roof across the angle between the faces and leaving it free to cave or subside in the mined area beyond the points. If the roof over the angle is considered as a beam supported at each end by the solid coal in the points, the length of span possible will depend on the character of the roof. The depth of cover will determine the amount of coal necessary to support the ends of such a beam and this will fix the degree of the central angle. It is hardly probable that the dimensions best suited to any particular roof condition can be determined except by experiment. The design was perfected in the summer of 1921.

The "Hoolamite," or activated iodine pentoxide indicator for carbon monoxide, is frequently used by engineers of the Bureau of Mines engaged in mine-rescue and recovery operations. The indicator gives immediate positive results with carbon monoxide in air in concentrations of 0.07 per cent or more. This detector has an advantage over the use of mice and birds in that a determination can be made in less than one minute, whereas it takes as long as 30 minutes before an animal will give an indication of gassing, in say, a concentration of about 0.1 per cent of carbon monoxide. No skill is required in making a determination. A qualitative detection of carbon monoxide in air in amounts greater than 0.03 to 0.04 per cent can be made by shaking a dilute solution of blood with the air, and then comparing it to an unexposed sample of similarly diluted blood. If carbon monoxide is present, the exposed samples will be pinker than normal blood.

Submarine Coal Mining.—Some interesting facts in regard to mining coal and iron ore under the sea in Nova Scotia and Newfoundland are given in a statement recently issued by the British Empire Steel Corporation, Limited, of Montreal. The seams in the Sydney, Nova Scotia, coal fields extend inland to a comparatively short distance from the water, but their extension under the sea is of unknown extent. These mines are now being worked under the bed of the ocean from varying distances up to two and a quarter miles, but how much farther out they extend has never been determined. The development and equipment necessary to operate coal mines under the sea is extremely expensive, requiring exceptionally powerful machinery. One of the new collieries now under construction will cost about $2,500,000 but it is expected that this expenditure will make available for mining approximately one billion tons of coal over a period of 120 years.—*Mfrs. Record.*

Potash in Texas.—The announcement in 1912 of the discovery of potash salts in cuttings and water from borings for oil established the probable existence of extensive deposits in Texas resembling those of the famous German region. There was no commercial exploitation of these resources during the war, but recent investigations of the United States Geological Survey supported by the additional findings of the oil drillers have confirmed the most optimistic predictions. In three wells recently drilled in Reagan County, Texas, potash beds were penetrated at depths between 1181 and 1687 feet. Within workable depths of about 1400 feet the cuttings yielded as much as 9.27 per cent K_2O, equivalent to 11.45 per cent of the soluble salts. This compares quite favorably with the average of the German mines. In the opinion of leading geologists Texas potash constitutes America's most important single natural resource still awaiting commercial development. With the increasing use of fertilizer, as well as the broadening industrial demand for potash salts, the day is not far distant when this country will be requiring each year a million tons of actual potash, or four times its present annual consumption. It is the opinion of Dr. Charles W. Dabney, former Assistant Secretary of Agriculture, that this demand will come within the next two decades. The district extends perhaps 650 miles north and south from central Kansas through Oklahoma, New Mexico and Texas and it varies between 150 and 250 miles from east to west.—*Chem. and Met. Eng.*

Rock Dust properly used in coal mines to prevent coal dust explosions is not a hazard to the health of the miners, according to Dr. R. R. Sayers, Chief Surgeon of the U. S. Bureau of Mines. It is true that dust produced in metal-mining operations is often the cause of miner's consumption, but this is because of the peculiar character of that kind of dust, according to Dr. Sayers. In drilling operations a dust is often produced that is very irritating to the lungs, and the continual breathing of this dusty air produces a bad effect. In coal mines, the rock dust used for limiting explosions does not remain in the air to be breathed, but settles on the sides and bottom of the workings. In addition, dust that is not irritating is used for this purpose. Limestone dust made from limestone that is free from silica is best for this purpose, but shale dust, clay dust, and other dust can be used. Dr. Sayers suggests that a mining company about to introduce rock dusting into its mine should submit a sample of the dust to the Bureau of Mines to be analyzed.—*Coal Age.*

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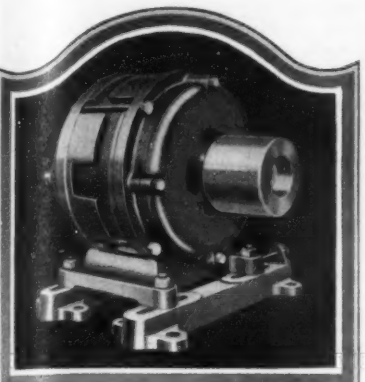

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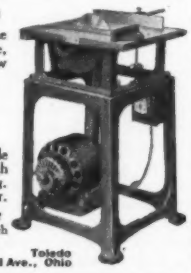

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West Point Military Academy

(Continued from page 150)

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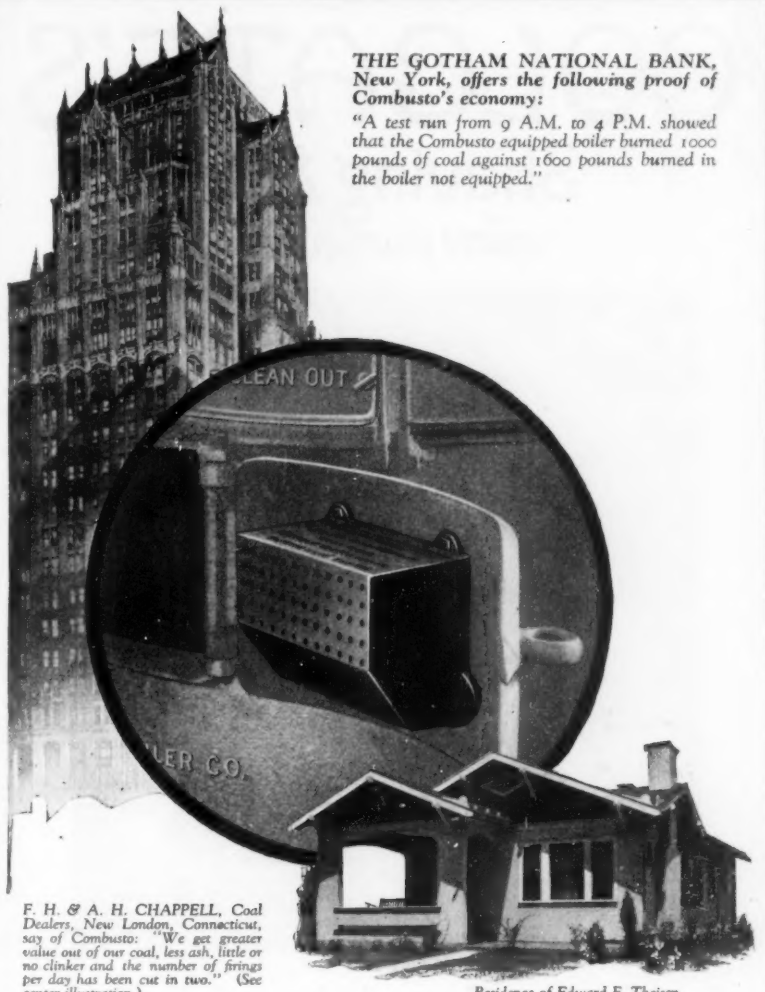
In describing the difference between the Corps at West Point and the students at other institutions, Colonel M. B. Stewart, Commandant of Cadets, states that the Corps differs in the degree and quality of its democracy. If that term be used to express a complete parity of opportunity, purpose and privilege in the Corps of Cadets, we have an actual practical example of the melting pot, a melting pot that never fails to function, and whose product is both unvarying and enduring. The rich man's son and the poor man's son lose their identity in that of the Cadet.

That the discipline, the education, and fine ethical atmosphere of West Point produce well-rounded men, who are a great asset to the country, is shown not merely by their military record, but by their activities in the industrial, economic, educational and political life of the United States. For proof of this listen to the following record: Beginning in the year 1820, the Explorations Service of the Western Empire beyond the Mississippi by West Point men blazed the way for advancing civilization. "Nine-tenths of the recorded geographic knowledge of the great west, prior to 1870, was due to the work of the army, almost entirely performed or directed by graduates of the academy." These labors included the great International Boundary Service, surveys of the Great Lakes, the organization of the Coast and Geodetic Survey, the construction of the first railroad in America, the building of the Chesapeake and Ohio Canal, the Moscow and St. Petersburg Railroad, the great Neva bridge, the Eads bridge, and the first railroads in Cuba, Mexico and Panama; the water systems of Philadelphia and Washington, most of the pioneer railroad of the United States; the Croton water supply for New York; the Washington Monument; the dome of the Capitol; many famous lighthouses and river and harbor works, and finally — greatest work of them all — the Panama Canal. These works were conducted, in their most important executive and advisory capacities, by graduates of West Point. Also, when Dr. J. H. Findley, as president of the College of the City of New York, made an investigation to determine the value of college education as a factor of success (an investigation based upon 20 leading institutions), he gave to West Point the highest percentage; for he found that from its graduates in their after life the United States secured 2 presidents, 4 cabinet members, 2 ambassadors, 4 plenipotentiaries, 12 consuls, 24 Congressmen, 18 governors, 45 presidents of colleges and universities, 87 presidents of railroads and corporations, 2 famous astronomers, 2 noted geologists, 3 celebrated physicists, 6 distinguished clergymen, among whom was included a bishop. Finally, it should be mentioned that, a complete bibliography of the first hundred years of graduates' writings showed 16,000 titles.

We commend these facts to those peace fanatics, to whom the name or sight of a military man is anathema.



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The Spellbinding Kilowatt

(Continued from page 154)

Cathedral, New York; the Universal moving picture studio, Los Angeles, and elsewhere. One has been installed on a truck by the U. S. Signal Corps for military use. The smallest size is for rooms up to 85,000 cubic feet, and is now in service in 16 churches throughout the country, 11 hospitals, and 12 hotel banquet rooms.

Automobile tourists who visit the camping ground at Schenectady this summer will be furnished radio entertainment by the municipality. A giant, hornless loud-speaker that emits signals equally from both sides, has been installed near the camp ground, and listeners within 500 feet of the apparatus may enjoy music and speech of great volume and free from distortion. It is known as an induction loud-speaker, and was developed in the Research Laboratory of the General Electric Company.

The induction loud-speaker is quite different in every respect from the household variety of loud-speaker using a horn. Dr. C. W. Hewlett, physicist, is the inventor of the device, which, until its installation in the Schenectady park, has had only limited use in public.

The speech amplifier has been made in many different sizes, but the type used to entertain tourists and residents of Schenectady, measures 42 inches in diameter. The working diameter of the diaphragm is 36 inches. The device consists essentially of two large flat coils of wire mounted close to one another in a frame which holds a thin aluminum diaphragm between the coils. These coils carry direct current which produces a radial field in the space occupied by the diaphragm, and these same coils carry the amplified voice currents and induce in the diaphragm corresponding currents which, by their interaction with the radial magnetic field, cause the diaphragm to vibrate and give off sound waves.

Briefly the features of the new amplifier are: It has no iron in it and does not depend on permanent magnets. No horn is necessary as is the case with the ordinary loud-speaker. Sound is thrown out equally from both sides. The diaphragm is acted on at all points of its surface so that it vibrates as a whole rather than being allowed to break up in partial vibrations. The large size of the diaphragm enables it to emit efficiently the low components of the tones in speech and music. This results in much more natural reproduction than can be obtained from ordinary types of loud-speakers. This is particularly noticeable in the reproduction of piano music. The induction loud-speaker is very substantial in construction. It is practically impossible to damage it or get it out of order. When occasion calls for it, a speaker may deliver large volumes of sound, as when addressing a large audience.

The amplifier on Schenectady's camping ground is erected in a small building which may be thrown open on both sides. In a neighboring building is a motor-generator set which supplies three kilowatts of direct current power to polarize the loud-speaker. The amplifier for supplying the voice current is divided into two parts, a voltage amplifier and a power amplifier. The voltage amplifier consists of two stages of 201 A Pliotrons and one 210 Pliotron coupled in cascade by resistance and capacity. The power amplifier consists of a one-kilowatt low impedance Pliotron. The plate current for all these tubes is supplied by a 2000-volt, full-wave kenetron rectifier which is operated from the alternating current lighting mains. Filament current for the tubes is furnished by transformers.

The radio programs of WGY, the General Electric Station which is located only four miles from the park, are picked up by means of a loop about 15 inches in diameter situated 15 feet from the loud-speaker. A receiving set will be installed soon and tourists may, on request, hear their favorite station—static permitting.

Our Abrams Verdict

(Continued from page 160)

mental in bringing E. R. A. to the attention of the public and, what is more, serving as an endorsement of the technique. After all, the public uses very little if any judgment in such matters: if a magazine editor says that a highly intricate medical technique, of which he knows absolutely nothing, is a marvelous panacea or cure-all, it must be so! If Upton Sinclair says the Abrams method is the last word in medicine, again it must be so! and then the testimonials!

The long and short of it is that given the initial publicity, the E. R. A. movement soon got under way. Suffering humanity in many parts of the world, ever searching for some straw, sought such doctors and practitioners as had the Abrams apparatus. The story had been so well told that persons with cancer, tuberculosis, real syphilis and so on were convinced beforehand that the electronic treatments would give them the relief which they sought. And then there was the usual flood of testimonials, telling how cancer was cleared up after orthodox doctors had given up, how tuberculosis had been defeated by the oscilloclast, and so on and so on. In this respect electronic medicine was quite like the quacks of the past.

The Doctor as a Business Man

We have come to look upon the doctor as an institution. He is ready for us when we need him. We call him when in want of medical attention, but ordinarily we never give him a thought. Whether he makes a fair living or not is no concern of ours.

Now the doctor, just as any other human being, has a living to make. What is more, he desires the same luxuries of modern life as the rest of us do today. Still, your average doctor goes about his work as a matter of rigid duty. There is no occupation in the world which entails so much unpaid-for work as that of the average doctor.

As the electronic reactions method gained ground, the doctors became more and more conscious of a change in their little world. One by one their patients would ask for the Abrams treatment, and on being told this treatment was without value or, at best, unproved, these patients would seek treatment elsewhere. Indeed, the writer knows of several instances of doctors who, refusing to take up the Abrams method, were all but driven out of business through the falling off of their practice. A year or two ago the average orthodox practitioner could sense the installation of an oscilloclast within a radius of 25 miles, by the marked dropping off of his practice.

Can we blame the average orthodox physician, already none too prosperous, for giving the public what they demanded? Certainly not. Hence it was not surprising to find hundreds of orthodox doctors hurrying out to the laboratory and school of Dr. Abrams. Once there, they were put through a four-week course of training, which consisted of little more than watching Dr. Abrams run through one blood specimen after the other—specimens, by the way, which were being sent in from all over the country, accompanied by considerable payments. Thus Dr. Abrams was going about his own diagnostic work, and making the school course—practically a ringside seat proposition—a profitable by-product.

The orthodox doctor was a very much puzzled man amid his new surroundings. He was given to understand that much of his medical training was of little or no value in the face of this new and precise electronic method. He was shown all sorts of things that could be done by means of the electronic reactions, until he simply yearned to do the work himself. He was asked to see the blanching of the abdominal skin in various areas, and when he failed to agree with his instructor he was made to feel quite alone and ridiculous in his failure. The majority of the class saw, heard and felt all kinds of things under the direction of the instructor, hence it was but a matter of time when our orthodox doctor also began to see, hear and feel without hesitation. The electronic reactions were so wonderful yet so elusive that it was considered a marked achievement to elicit them.

The course completed, such as it was, the orthodox doctor signed up for a diagnostic and treatment equipment and went home with a buzzing, confused head, ready to give his patients the Abrams method for which they had been clamoring.

Meanwhile, Dr. Abrams found it advisable to lower the standards of electronic practice. At first he intended that this work should be done only by doctors with an M. D. degree; but soon he was admitting osteopaths, chiropractors, dentists, naturopaths, and so on. So, our doctor soon found himself thrown in with strange bed fellows. Then, to make matters still worse, he soon got into difficulties with his local medical association, which had no use for the electronic therapy, having declared the thing a fake and barred any of its members from using it. However, he had been told in San Francisco that the medical associations were

narrow, old-fashioned and autocratic, and his sense of sportsmanship prompted him to give E. R. A. at least a fair chance.

Again the Tricky Sub-Conscious Mind

Our orthodox doctor, sincere in this work from the very beginning, received little more than a very rough idea of electronic work during his $250 course in Dr. Abrams' school. Once back home and with his newly acquired apparatus, he set to work seeing what he could do on his own account with the electronic reactions. He began his first experiments on simple things, like cancerous flesh specimens and germ cultures in vials supplied by a San Francisco E. R. A. supply firm, and tried to elicit the reactions. He knew what they were like, for he had been told about them. He knew where they should appear on the abdomen of his subject, for he had a so-called "atlas," indicating just where these reactions would appear. So, spending day after day, our doctor tried by the hour to feel the reactions. By constant practice he finally got the reactions. Sure enough, the rod did stick, as Dr. Abrams said it would! Or if he were using his finger tips to sense roughness in a given area, sure enough he could barely feel a slight difference in the texture of the skin! Again, if he tried percussion, sure enough, there it was! Whereupon he was greatly elated.

Once capable of eliciting the reactions, our orthodox doctor was ready to practice electronic medicine as an accessory to his regular medical work. About this time he was called upon to resign from his medical association or give up electronic work. Perhaps he gave up electronic practice, but if so, it meant a heavy financial loss, not only through loss of practice, but through the heavy investment he had made in the Abrams equipment. If courageous, he stuck it out, and became an "irregular" in the medical ranks.

Our "irregular" doctor began to handle his patients with the electronic method. He soon found that the reactions were not at all positive. Sometimes they were clean cut; sometimes they were not. The best results were had when the doctor knew something about the case. Even though Dr. Abrams had apparently worked on blood specimens from unknown cases, and had obtained, so it seemed, brilliant findings, our doctor found it most difficult to work out a satisfactory diagnosis without some case history. Still, the oscilloclast did seem to do some good in several cases which did not respond to orthodox methods, and that alone kept the doctor going.

Then, certain individuals began to play tricks on him. Someone sent him chicken blood, which he diagnosed as the blood of a man with congenital and acquired syphilis, cancer, tuberculosis, strep., and so on. Soon this story became known and made things very embarrassing for the doctor. Other tricks were played on him from time to time, until he finally arrived at the conclusion that the reactions were by no means reliable, especially in his hands. Again, he might arrive at the conclusion that the whole thing was a delusion—a trick of his subconscious mind. Our Committee has come across many instances of honest doctors who took up electronic work, spent a year experimenting with it, saw the fallacy of the entire thing, and then gave it up, pocketing their losses and saying no more about it.

Meanwhile the other kinds of doctors—many of them products of the notorious "diploma mills"—finding the electronic method a veritable gold mine, paying anywhere from $200 to $500 per week as compared with $100 or less per week for the usual orthodox doctor's practice, flourished in this work irrespective of whether their results were convincing or not. These miscellaneous doctors became members of various electronic societies and similar organizations, and attended all the meetings. And when one of them found the courage of other electronists drooping as the result of adverse criticism, press attacks and a gradual awakening on the part of the public, he proclaimed more than ever the marvels of electronic work in his everyday practice. With less scrupulous doctors the electronic reactions have fared best, to be sure.

What of the Poor Patient?

So much for the practitioner. Please note that the honest doctor has been a victim of this electronic thing just as much as the general public. Indeed, when the Abrams apparatus has failed, the honest doctor has bought some other make of electronic apparatus for which still more lavish claims were made. At the height of the electronic craze there were 44 well-known makes of electronic, radio, radiant energy and other pseudo-scientific instruments all based on the hide-and-seek electronic reactions of Abrams. There was a mint of money in the manufacture of these instruments. A simple slide-wire wave-meter, intended for the tuning of the electronic waves and costing less than $25 to manufacture, was sold for $250. A simple air-gap device, for measuring the intensity of the electronic waves, was sold for $150. A crude resistance box, worth $2 as electrical apparatus, brought $25 or more as electronic apparatus. And so it went. The manufacturers of electronic equipment have been making money on the practitioners, and the practitioners, in turn, have been making money on the patients.

Turning to the patient, the electronic method has had an interesting effect. The patient has approached the electronic practitioner with that same awe as the religious devotee's approaching a shrine noted for its miracles. The patient has been impressed in advance through literature and word of mouth, with the wonderful curative effects of the electronic treatment. Even though the orthodox doctor may have found little if anything wrong with the patient, the electronist soon discovered a long list of electronic irregularities which substantiated the patient's apparent ill health. Or, in cases where orthodox medicine had decreed an operation, such as in cancer cases, the electronist suggested the electronic treatment as a means of escaping the surgical knife. To be sure, the electronic method, without knife or drug, was far more pleasant than the old orthodox idea.

Just as faith cures are highly effective in given cases, so the electronic method has been successful. Electronic records show numerous cures which may be accepted as bonafide, but which are due to nothing more impressive than the will to believe that one will get well. A review of the numerous published case reports and glowing testimonials supplied by electronists has revealed few results that have not been obtained equally well by a faith healer or any of the charlatans of the past.

On the other hand, this investigating Committee has come across numerous cases of rank E. R. A. failure. We have had persons come to us and tell of their sad experiences. And these experiences have indicated that the procedure is always about the same: the patient is told he has this, that and the other thing. He is given the oscilloclast treatment. He is told he is getting better, as disclosed by his blood tests. Finally, he is told his ohmages have been cleared up, and that, if he is not feeling better, nothing can be done but to let nature take its course. The electronist originally agreed to remove the troublesome ohmages; this he has done; and now that the body has been cleared of the fertile soil on which disease thrives, nature must be given the chance to put the house in order.

The Scientific American Investigation

Despite bitter attacks from here and there which were immediately refuted with plausible arguments, electronic medicine went its way, gaining more and more adherents among doctors and near-doctors as well as suffering humanity. The more it was attacked the more it became firmly imbedded with its followers, until it achieved something of a religious nature rather than a new school of medicine. And as it gained ground as the result of its own claims, its followers lost not a single opportunity of damning regular medicine and sowing medical anarchy wherever they could, until many of us began to wonder whether, after all, the old school of medicine was hopelessly obsolete and, what was worse, was refusing to be brought up to date.

E. R. A. gained and gained. Early in 1923 there were well over 3500 electronic practitioners at work, and many more, no doubt, not identified with the simon-pure Abrams technique but using something slightly different and also based on the elusive reactions of Dr. Abrams. The movement was gaining ground in Great Britain, not only because of the endorsement given to E. R. A. by Dr. Sir James Barr and other well-known British doctors, but because of the well-known enchantment of distance. Electronic workers in Great Britain saw to it, no doubt, that the most favorable morsels of American electronic news and

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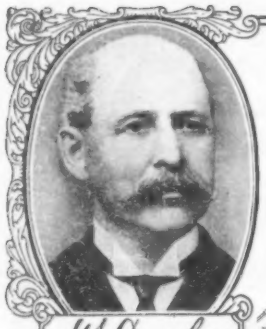

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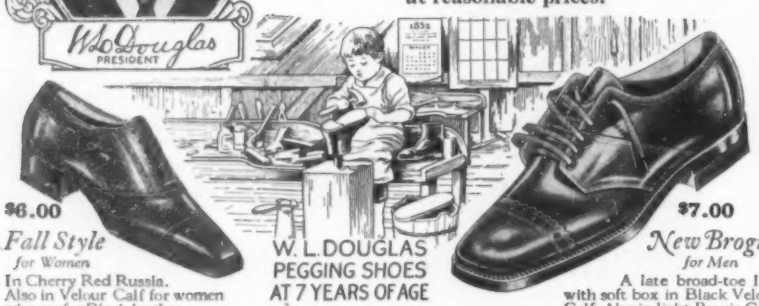

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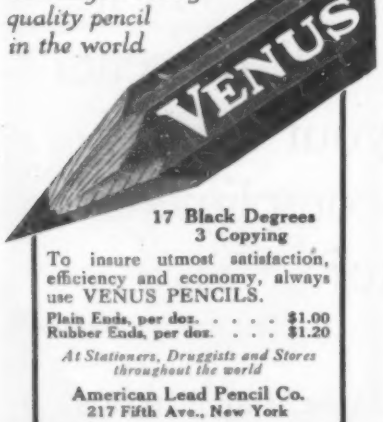

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fables were served to the British public. Germany was interested in this wonderful American invention for curing ills. French journalists, looking for thrilling copy, gave some space to Dr. Abrams and his work. Even in far-off Australia there was a vigorous campaign afoot to have electronic medicine officially recognized and endorsed by the State and to afford its benefits to the poor working class.

At this point the SCIENTIFIC AMERICAN, quizzed on all sides regarding this electronic matter and called upon for a definite statement of opinion, decided to enter into a first-hand investigation of the facts involved. The situation by now was sufficiently grave. We must either endorse or reject electronic medicine: there was no middle course. In our October, 1923, issue, we published the preliminary announcement of our intentions. We received the hearty endorsement of the electronists, headed by Dr. Albert Abrams himself, who offered to place all their facilities and their services at our disposal, to the end that the truth might at last be presented to the public.

The story of our investigation has been told month by month in the columns of this journal, hence we need not review the case in great detail. Suffice it to state that in the beginning it was generally held that we were biased, if anything, in favor of the electronists. We were more than fair to them. We were more than charitable in our interpretation of their work.

Step by step we took up the thread of our investigation, starting with our negotiations with Dr. Abrams himself to have him undergo simple tests, which he refused to do even up until two days prior to his death on January 9 of this year; then came our tests with the famous Dr. X, who, by the way, has since been arrested for practicing medicine without a license; our voluminous correspondence with electronists far and wide; our blood tests with several electronists who failed to produce even a scintilla of proof as regards the basic value of their diagnostic procedure; our visits to E. R. A. practitioners so as to observe their work under everyday conditions; our interviews with electronic leaders, electronic manufacturers and self-termed electronic engineers, and so on; our five months' cooperation with members of the International Hahnemannian Association who have endorsed the electronic reactions technique yet have been unable to prove to us that their work is anything more than sheer subconscious guesswork, as regards the diagnosing of blood specimens as well as the selection of homeopathic drugs; our study of case reports with a view to learning whether the results, if true, could be something more than Coué ism in pseudo-radio dress; our examination and experimentation with the Abrams apparatus at first hand; our visit to the Burnett-Timken Research Laboratory and the utter failure of the staff of that private research laboratory to substantiate the claims made for the oscilloclast at the time; and, finally, our long series of tests with a leading electronist, who was to demonstrate to us, beyond the shadow of a doubt, the objective reality of the electronic reactions and why they had been so elusive and so mystifying in the past.

All this mass of work has been done by the SCIENTIFIC AMERICAN Abrams Investigation Committee, to the end that an unbiased, clean-cut, final opinion might be rendered as to whether the so-called electronic reactions of Abrams and its numerous derivatives constitute one of the greatest discoveries of all time, opening up fresh vistas to the suffering humanity of the world, or, on the other hand, the greatest piece of charlatanism in history.

A Well-Organized Movement

It is the belief of this Committee, based on its observations and experimentation, that the so-called electronic reactions do not exist. They are either faked by the unscrupulous practitioner, or, when the practitioner is sincere, they are baffling products of his subconscious mind. This Committee does not believe that a blood specimen gives off energy, electronic or otherwise, that can be led through wires and detected by means of abdominal reflexes. This Committee does not believe for a moment that any electronic worker can identify similar blood specimens from among miscellaneous blood specimens. All these things cannot be done under cold, clean-cut scientific test conditions. Whatever has been done in everyday practice and under tests conducted by the electronists themselves, has no value in our deliberations.

This electronic technique has been conceived by a master mind. It is far more intricate and ironclad than medical fads of the past. It deals with a new form of energy which, we are told, cannot be detected by the physicist's most delicate instruments, but can be detected by the abdominal reflexes under the guidance of an electronic diagnostician. These reactions are said to be affected by the presence of skeptical minds, radio broadcasting waves, steel work in buildings, weather, and so on. The conditions are said to be so delicate that diagnostic failures can always be laid to the contamination of the blood specimen through ordinary handling. The reactions come and go for no apparent reason, and at the crucial moment of a test the reactions usually fail entirely because the reagent is exhausted, electronically speaking. But in everyday practice, the electronic reactions apparently work without a hitch.

The orthodox doctor cannot follow very far in the electronic deliberations. He is out of his element if he does. Should he produce a patient with tuberculosis in the last stages, and the electronic blood examination pronounces the patient to be dying of cancer, the correct answer is cancer and not tuberculosis. The electronic answer, of course, is the correct one, always. Hence the doctor is simply out of his element.

The electrical engineer and the radio engineer find themselves at sea when investigating the apparatus. True, it utterly fails to make sense on the basis of electrical or radio reasoning, but then this is not electricity or radio waves—it is electronic. Thus the electronic field is again barred to others.

Thousands of doctors and near-doctors have entered the electronic fold. They have gone about their work of diagnosing and treating that part of the public which seeks something new in medicine as well as in clothes and automobiles. So-called radio men have found lucrative employment in working for electronists as "engineers." Many a small manufacturer has found a profitable field in turning out all manner of pseudo-radio devices called electronic diagnosis and treatment apparatus. And all of this activity comes right down to the so-called electronic reactions of Abrams, which, according to this Committee, do not exist.

Meanwhile, this electronic development has caused a sad state of affairs in this world of ours. It has given rise to all sorts of occultism in medicine. It has been a renaissance of the black magic of medieval times. It has given free reign to idiotic ideas—ideas which would formerly have been laughed out of existence at their very start. Suffering humanity has been made so many lavish promises of late that it is a sad disillusion now to go back to our conservative orthodox medicine, which, after all, remains our mainstay.

There may be a time, and that not so far distant, when we shall have worked out some method of harnessing the very delicate currents within the human body for the purpose of accurate diagnosis. Already we have the wonderful electro-cardiograph which enables us to detect the effect on the heart action caused by taking a puff from a cigarette. An ultra-sensitive galvanometer will detect human emotions in a general sort of way. Here and there serious workers are endeavoring to study these delicate electrical currents within the body. However, when the day arrives for the practical application of such serious research work, we may be certain that it will have nothing in common with the passing electronic craze. In so far as concerns the apparatus employed, the methods of exploitation, or the qualifications of the men engaged in the work, it will be wholly without resemblance to the cults, whose basic ideas and whose technique this committee denounces.

The British Empire Exhibition—I

(Continued from page 168)

produce, fruit and fisheries. The latter section illustrates the sporting possibilities of the Dominion, for specimens of swordfish and kingfish and other destructive deep-sea monsters, are shown in blocks of ice. There are also exhibits of wool, hides, skins; and of tallow, minerals, seeds, honey, kauri gum, poultry, flax, timber and other secondary industries.

A garden two acres in extent adjoining the pavilion gives a representative display of New Zealand plants, trees and grasses. An interesting feature of these grounds is the carved Maori house, which was erected in 1874 on the ratification of peace between

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the two Maori tribes which had been at war for many years previously. A cinema theater is contained in the pavilion in which films are shown depicting New Zealand life and Maori customs and folk-lore; and at the restaurant one can obtain meals entirely from New Zealand products. A photograph of the pavilion entrance is shown with the main body of this story on page 168.

Wembley, throughout the whole period of the exhibition, is to be the scene of a series of highly important conferences. These will be held in the four Congress Halls which have been specially erected with the necessary committee rooms for the purpose, at the northeast corner of the grounds, accommodating respectively 120, 150, 550 and 1800 people. Each conference is being arranged by an appropriate imperial, or national organization. Chief on the list are the Mining and Metallurgical Congress held in June, in which the principal organizations connected with the mining industry participated; and the first World Power Conference, from June 30 to July 12, organized by the British Electrical and Allied Manufacturers' Association. From July 14 to 19 was held the International Advertising Convention, organized by the Associated Advertising Clubs of the World. Other conferences of more than average appeal to Americans are that of the Alliance of Honor, dealing with moral education, August 25 to 30; the Eugenics Education Society, meeting every Wednesday in June, August and September; the Educational Union, to consider spiritual values in education, September 2 to 4; the Cancer and Health Conference of the Health Propaganda Association, scheduled for June 26 and October 9; the International Council of Women, October 27 and 28; and the Conference on Social Work in the New Age, engineered by the Universal Brotherhood Campaign, and scheduled for July 28 to 30. These of course are only the gatherings of international interest and significance; it would be impossible to list all the conferences to which the Wembley program will give a place.

The chief purpose of the World Power Conference is to consider how the industrial and scientific sources of power may be adjusted nationally and internationally; and with this end in view the papers read and discussions at the conference will deal with the following subjects: (1) the potential resources of each country as regards hydro-electric power, oil and minerals; (2) the practical results obtained by the development of of these resources, and the development of scientific agriculture, irrigation and transportation by land, air and water.

Civil, electrical, mechanical, marine and mining engineers, technical experts and authorities on scientific and industrial research, consumers of power and the manufacturers of the generating plant and machinery, are all expected to take part in the gatherings and discussions. The financial and economic aspects of industry, the possibility of establishing a permanent World Bureau for the collection of power data; and the preparation of inventories of the world's power resources, will be considered; and it is hoped that one result of the conference will be to promote the exchange of industrial and scientific information through appointed representatives in the various countries in and out of the empire.

With these ends in view the conference has been divided into five divisions: (a) power resources; (b) power production; (c) power distribution; (d) power utilization; and (e) general. Each division is again divided by the various types of resources, into sections, where the experts can communicate the contribution their country has to make, or can survey the possibilities of the future. In the last division, the subjects touch very closely on national life; for they cover education, health, industrial conditions, and finance.

Over 30 nations are taking part in the proceedings, and have promised to send official delegates; and over 300 papers have already been promised for the conference. A number of these will deal with a question of overwhelming importance—*the international standardization of parts;* the establishment of which would, it is believed, reduce very materially the cost of electricity, both for power and illumination.

Coincident with the conference, but arranged separately, the Kelvin centenary celebrations will be held, and will include presentation of the Kelvin medal to Professor Elihu Thomson, perhaps the greatest living electrical authority in the United States. The centenary banquet, over which the Earl of Balfour is to preside, will form a fitting conclusion to these celebrations.

Giant Submarines

(*Continued from page 172*)

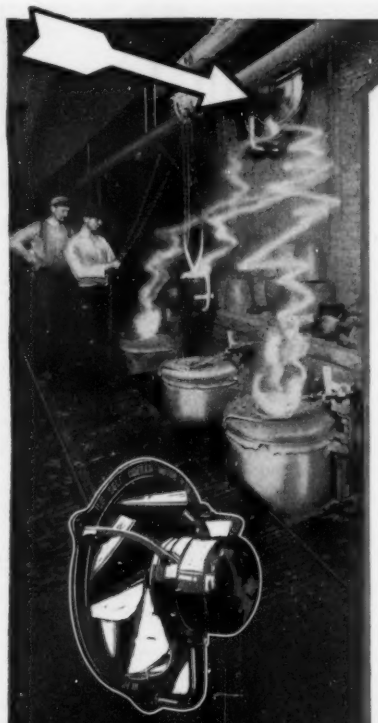
submarine is looked upon today as an ocean-going ship, with a cruising endurance greater than that of any surface man-of-war of corresponding tonnage. To the United States Navy, submersible cruisers of 2500 to 3000 tons, or even greater displacement, would be of extraordinary value in any future campaign it may have to wage. If equipped with high-power radio plant and fitted to carry one or more small airplanes, they would be capable of performing efficient service as scouts or observation patrols in areas remote from any friendly base. In fact, the possession of an adequate number of these big submarines would go far toward simplifying the problems with which American naval strategists are faced, the peculiar nature of which need not be labored here. But when we come to consider Professor Flamm's 7000-ton undersea cruiser, its practical value does not leap so swiftly to the eye. One assumes it to have been designed primarily as a destroyer of commerce, since despite its heavy armament and protective plating it would stand no chance in action with any surface cruiser of equivalent size, which would have the advantage over it in speed, armament, range of vision—and therefore of effective gunfire—and, above all, in the ability to resist several direct hits without necessarily suffering disablement. It may be accepted as an axiom that no submarine will ever engage in an artillery duel with a well-armed surface ship if it can possibly avoid the encounter. But for commerce-raiding purposes the Flamm submarine seems unduly large and powerful. True, its 8.2-inch guns would enable it to "shoot up" any convoy which was escorted only by sloops or feebly-armed cruisers; but once this danger had been recognized the assignment of stronger escort ships, mounting heavier guns, would follow as a matter of course. That the appearance of a dozen or more 7000-ton U-cruisers on the ocean highways would cause much embarrassment and lead to heavy casualties among shipping is beyond dispute. But that the danger could not be countered in time to prevent defeat is a theory to which recent war experience lends no support.

In the judgment of most officers with practical knowledge of submarine work, the technical difficulties of navigating very large boats in submerged condition are, and will remain, insuperable. These difficulties were lucidly explained by Commander Fechter, a former German U-boat captain, in an article contributed to the *Marine Rundschau* last year. A small or medium submarine, he pointed out, could be handled with perfect confidence by the captain, who not only had all essential control gear under his hand, but could see with his own eyes how every order he gave was being carried out. In large submarines this system of one-man control is impossible. Part of the responsibility for working the vessel must be delegated to subordinates, who are not visible to the captain; and no matter how perfect the intercommunication between the various control stations may be, that instant transmission and execution of orders which is so vitally important when the submarine is running below the surface and preparing to attack becomes impossible. In Commander Fechter's opinion, there would be practically no change of keeping a big U-cruiser on a perfectly even keel at periscope depth, which means that torpedo attacks would generally fail. It would seem, therefore, that Professor Flamm has designed a submarine which, remarkable as it may be from the technical viewpoint, has no clearly-defined rôle in the present scheme of naval tactics, and would therefore not repay the cost and labor involved in its construction.

The Battleship "Mississippi" Disaster

(*Continued from page 176*)

just below the turret floor. The shells are carried up to the breech of the guns by electrically-operated shell hoists. The powder is passed up from the ammunition-handling room to the breech of the gun by hand, and as a protection, the openings are covered by steel trap doors, which shut down automatically after each bag is passed through. It should be explained, also, that there are steel trap doors covering all of the electric ammunition hoists, and these doors are strong enough to resist the pressure due to an enemy shell penetrating and bursting within the turret above. From this description it will be seen that the lessons of the "Georgia" and "Missouri" explosions



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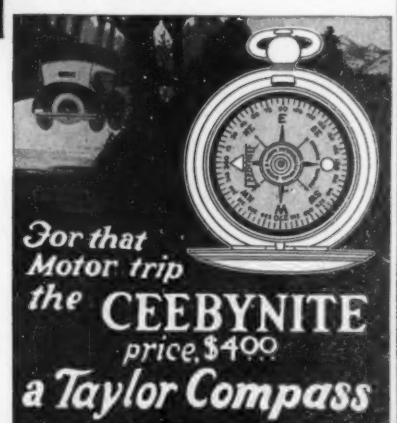

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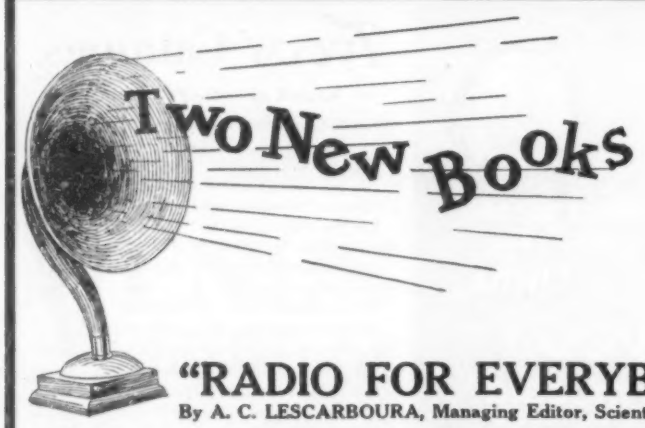

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were well learned and have been amply provided against. It is scarcely possible that the flash of a shell bursting within the turrets could go through to the magazines below, as happened in the case of the lightly armored British battle cruisers which were blown up during the battle of Jutland.

Having seen the precautions taken to protect the magazines, let us now look at the devices by which the men in the turret are protected against flare-back and against any other untoward incident that would imperil their lives. At the left of our smaller group of drawings is shown a sketch of the breech of a big gun, in which we see a shell and behind it the four bags of powder, to the rear of which is the closed breech block. This is shown on a larger scale in the lower right-hand sketch, where it will be noticed that between the powder bags and the breech plug there is what is called an obturator. This is a flexible pad which, under the pressure of the gases at the moment of explosion, expands so tightly against the walls of the powder chamber as to prevent any escape of the white-hot gases of explosion to the rear. The larger drawing and the end view of the gun show the method which was adopted over 20 years ago to clear the unburned gases and any burning fragments out of the gun immediately after it had been fired. It consists of a circular air pipe about one inch in diameter, from which lead from four to six small holes which are bored at an angle of about 40 degrees into the breech box. This pipe is supplied with air at a pressure of 150 pounds, and to make sure that, during rapid firing, the full pressure is always available, there are accumulator tanks (fed by air compressors in the engine room) at each turret from which the supply is drawn.

Immediately after the gun has been fired and at the instant the breech plug begins its unlocking rotation, a valve is tripped and the air begins to rush into the breech of the gun, the flow of air continuing throughout the whole process of withdrawing the plug. This rush of air sweeps out of the gun any unburned powder gases, unburned fragments of powder, or bits of burning silk, etc., and it continues until the plug is entirely removed. One of our photographic reproductions of the firing of a gun shows this airblast as it is discharged from the muzzle of the gun. It will be noticed that the burned powder shows in this picture as dense black clouds of smoke. As seen by the eye, the powder is a light brown color and not dense; the black effect is due to the fact that the powder gas immediately following discharge is red hot, and its effect upon the photographic plate is to produce this black appearance. The cold air for cleaning the gun is not subject to this camera effect and appears white on the plate.

Following up our story, it should be explained that, according to the turret drill requirements, no powder is supposed to be in the turret at the time the gun is fired. Immediately after the airblast has been used, the gun captain looks through the bore and cries "Bore clear." Not until then is the ammunition brought up into the turret. First the shell weighing 1400 pounds is driven home, and then the powder charge weighing 370 pounds is rammed home, two bags at a time. While this is being done the primer man inserts the primer in the breech plug. The primer is a small cartridge-like affair which contains black powder and fulminate of mercury through which passes a fine electric filament. A small hole bored axially through the breech plug leads from the primer to the powder chamber, and through this, when the cartridge is fired, the flame reaches the powder charge. The primer functions when the electric filament is heated by the passage of an electric current. When the breech plug is open the firing pin, which is carried in a metal wedge, is not in contact with the primer.

As soon as the last powder bag has been rammed home and the breech plug has been primed, the latter is swung up on its hinges, which are attached to the gun itself, and closed and then rotated to lock the threads. The last of the rotating movement moves the wedge containing the firing pin into the firing position, as shown by dotted lines in our sketch, with the inner point of the firing pin resting upon the metal primer, and thus forming a continuous circuit from the firing circuit wire, through the firing pin and the primer to the gun and so on to the ground.

Now, the arrangement of the firing circuit shows what great care has been taken to safeguard the whole operation of gun loading and gun firing. There are in this circuit first the gun captain's switch, then the gun pointer's switch, and finally the turret officer's switch in the officer's booth at the rear of the turret, all of which must be closed before the gun can be fired. First, the gun captain closes his switch, then the turret officer completes his connection, and finally when the gun pointer closes his switch the electric current passes, heating the fine wire in the primer and discharging the gun.

Now with all these precautions, and with the very careful drilling of the crew, which takes place all the way from the magazine men below up to the gun-pointer who closes the last switch, or "pulls the trigger," the question may be asked, "How in the world did that frightful conflagration take place on the 'Mississippi,' with a loss of nearly half a hundred lives?" At present nobody knows with certainty, and it is possible nobody ever will know. But according to published interviews with the survivors, it would seem that the pressure gage on the airline used for cleaning the gun was low. This might well happen after several rounds had been fired at full speed, in simulation of battle conditions; for the air pumps are in the engine room and each turret depends upon the accumulator tank located near it, in which a sufficiency of air at high pressure is provided to meet the demands of rapid firing. If the air pressure was low, it may well be that some powder gas or burning fragments remained in the bore and were not observed by the man whose duty it was to look through the bore before fresh powder charges were brought up into the turret. It may be also that in the rush of competition and the desire to make records for speed, the next supply of powder bags was passed up through the trap door into the turret before the bore had been inspected and "bore clear" announced.

Whatever may be proved to have been the facts of the case, this tragic event will serve once more to warn our officers and men that "eternal vigilance is the price of safety."

Since the above was written the naval court of inquiry has reported. Its findings are in general agreement with what we had surmised. But there is one statement of profound and disturbing significance: "Prior to that time" the eighth salvo when the disaster occurred "namely, upon the completion of the loading for the third salvo, the left gun of No. 2 turret, fired prematurely, *while the firing circuit was open,*" the italics are ours. This we think could have been caused only by fire in the breech, and would indicate a foul powder chamber due to low air pressure.

The New Physics in the College

THE last few decades have witnessed some noteworthy advances in the science of education. It has been realized that in many ways the conventional methods of instruction have served to discourage the very qualities which it is most essential to encourage—the interest and initiative of the student. We well recall with what enthusiasm we encountered for the first time, in our own collegiate days, a text in mathematics which made it clear to us what each new step was about, before asking us to take it.

Perhaps no subject has remained further from this ideal than has physics. It has been customary to ask the student to read and master an abstract principle, say, about a body being acted upon by two forces, at a moment when he has never had his attention called to such an event. The general terms of the discussion make no appeal to his experience, suggest no mental picture—and he is lost. If, in the not-quite-so-extreme case, the student has had a particular case brought to his attention, in a cut-and-dried diagram preceding the discussion, he is not lost, perhaps, but certainly he is anchored to that diagrammatic case—which is as bad as being lost, so far as progressing to the next case is concerned.

Among the texts of the past year is one, "General Physics for Colleges," by Webster, Farwell and Drew, in which a definite breakaway from the old technique is scored. The authors first show the value of a principle or law by suggesting different actual and practical situations which involve that principle or law—real situations found outside the laboratory, such as any man with natural human curiosity might ponder over for his own satisfaction. After these motivating problems are stated, the principle or law is clearly explained, and then followed by further problems for the student to work out for himself.

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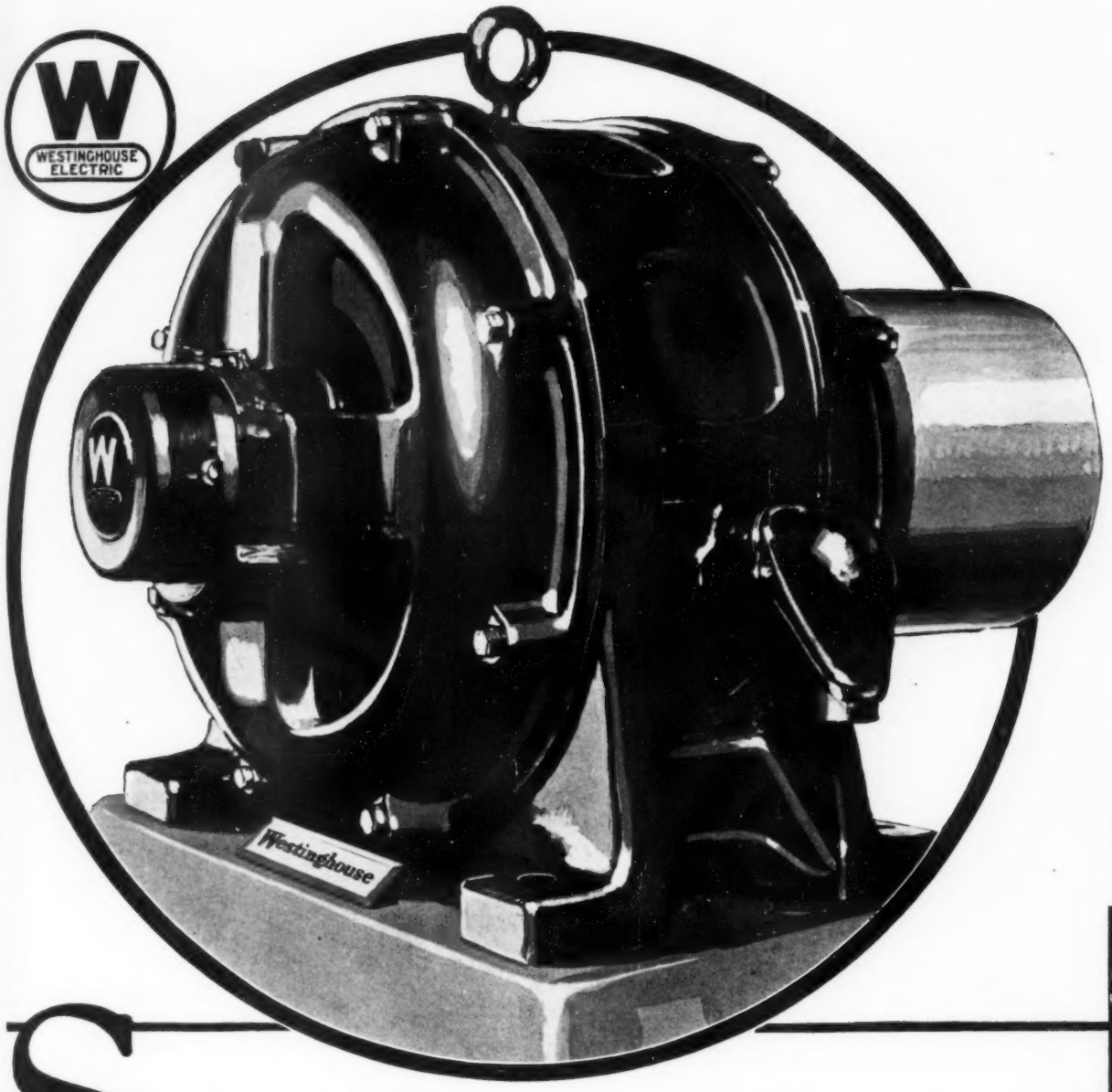

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